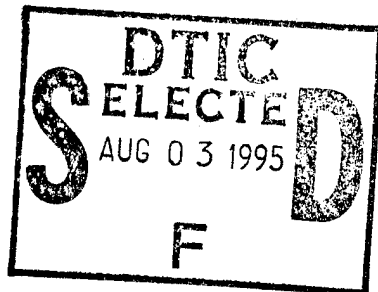


# NAVAL POSTGRADUATE SCHOOL MONTEREY, CALIFORNIA



## THESIS

**SECOND PRICE SEALED BIDDING  
IN  
GOVERNMENT CONTRACTING**

by

Donald L. Hertig

December, 1994

Principal Advisor:

Katsuaki L. Terasawa

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE DECEMBER 1994		3. REPORT TYPE AND DATES COVERED Master's Thesis
4. TITLE AND SUBTITLE SECOND PRICE SEALED BIDDING IN GOVERNMENT CONTRACTING			5. FUNDING NUMBERS	
6. AUTHOR(S) Donald L. Hertig				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (maximum 200 words) This study analyzes the use of second price theory as it pertains to competitive Government contracting. Second price theory, which was originally introduced by William Vickery in 1961, entails awarding the lowest responsible and responsive bidder in a sealed bid competition a Firm-Fixed Price (FFP) type contract, where the award price is set at the second lowest bidder's bid price. This study first defines the Second Price Sealed Bid (SPSB) method, a variant of second pricing, and provides the theoretical advantages for its applications in Government contracting. Following this, the thesis presents two sets of experimentation which identify bidding behavior when the SPSB method is applied in Government contracting. The study then discusses and analyzes survey responses received from both Government and private industry contracting professionals concerning the applicability of the SPSB method in Government contracting.				
14. SUBJECT TERMS Second Price, Second Price Theory, Second Price Sealed Bidding, Second Price Seal Bid, Second Price Sealed Bid method.			15. NUMBER OF PAGES 124	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18 298-102



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IN  
GOVERNMENT CONTRACTING

by

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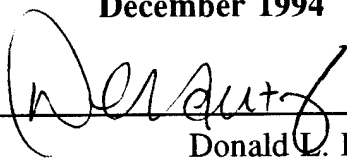
Submitted in partial fulfillment  
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

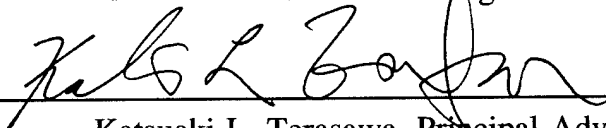
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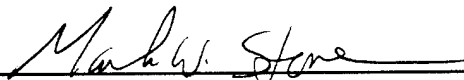


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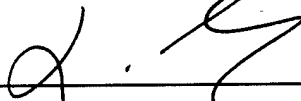
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## ABSTRACT

This study analyzes the use of second price theory as it pertains to competitive Government contracting. Second price theory, which was originally introduced by William Vickery in 1961, entails awarding the lowest responsible and responsive bidder in a sealed bid competition a Firm-Fixed Price (FFP) type contract, where the award price is set at the second lowest bidder's bid price. This study first defines the Second Price Sealed Bid (SPSB) method, a variant of second pricing, and provides the theoretical advantages for its applications in Government contracting. Following this, the thesis presents two sets of experimentation which identify bidding behavior when the SPSB method is applied in Government contracting. The study then discusses and analyzes survey responses received from both Government and private industry contracting professionals concerning the applicability of the SPSB method in Government contracting.

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## ACKNOWLEDGMENTS

I would like to first acknowledge the patience and understanding of my wife, Rocio. Throughout the drafting of this thesis, she continually provided her loving support.

Secondly, I give my sincerest thanks and appreciation to Katsuaki Terasawa, a true *educator* in the strictest sense, and Mark Stone. Despite their busy and hectic schedules, both gentlemen provided guidance and editorial comment for this literary work.

Finally, I extend a hand of thanks and admiration to David V. Lamm for his insight and lasting contributions to those individuals endeavoring to be “true” contracting professionals.

## I. INTRODUCTION

The world in which Department of Defense must operate has changed beyond the limits of the existing acquisition system's ability to adjust or evolve. It is not enough to improve the existing system. There must be a carefully planned, fundamental reengineering of each segment of the acquisition system so we can respond to the demands of the next decade. [Ref. 1, p. 8]

As reflected above by Mrs. Colleen Preston, the Deputy Under Secretary of Defense (Acquisition Reform), Department of Defense (DoD) is "carefully" approaching acquisition reform in a manner to better serve our national interests. In concert with the White House's National Performance Review (NPR), acquisition reform provides an avenue towards streamlining Government by way of introducing innovative procurement methods that contribute to the elimination of red tape and excessive oversight. Accordingly, this thesis presents one facet of acquisition reform by way of presenting an alternative method, referred hereafter as the Second Price Sealed Bid (SPSB) method, used in the solicitation of Fixed-Firm Price (FFP) type Government contracts.

### A. THE SECOND PRICE SEALED BID METHOD: AN OVERVIEW

The SPSB method is a derivative from the "second-price" sealed bid auctioning mechanism that was originally introduced by the economist William Vickery in 1961. [Ref. 2, p. 20] Although limited studies and publications have addressed the second-price auctioning mechanism, very little, if any, literature has attempted to apply second-pricing in contract acquisition.

In contracting for products and services the Government often uses the First Price Sealed Bid (FPSB) method in the solicitation of FFP type contracts<sup>1</sup>. Under the FPSB method, the Government issues a solicitation to prospective contractors who then submit their bids in a sealed envelope. On an appointed date and time, the envelopes are opened and put in full view of all contractors and Government officials. Under this type of solicitation, contract award determination is based upon the lowest bid offered. Accordingly, the contractor submitting the

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<sup>1</sup> The FPSB method is simply referred to by acquisition and contracting professionals as "sealed bidding." In that the SPSB method is currently not recognized as an accepted form of bidding, there is no common terminology to describe its use.

lowest bid is awarded the contract and, after performance of the contract, is paid by the Government the amount of their bid. Hence, the amount paid to the contractor would be referred to as the FPSB price. Under the SPSB method, the contractor submitting the lowest bid is also awarded the contract. In contrast to the FPSB method, however, the contractor is paid the bid price submitted by the *next-to-lowest* contractor, the second price.

As discussed in this thesis, the theory of the SPSB method implies that, in a competitive environment, a contractor's best long-term pricing strategy for submitting bids is to bid their actual anticipated cost in providing a product or service. The incentives for bidding this amount are:

- bidding *higher* than their actual anticipated cost *increases the risk* of not being the lowest bidder, therefore losing the award and,
- bidding *lower* than their actual anticipated cost *increases the risk* of being awarded a contract in an unprofitable position (this would occur where the next-to-lowest bid is lower than the offeror's actual anticipated cost in providing a product or service).

Continuing with this theory, determining an contractor's pricing strategy is dramatically simplified in that their optimal pricing strategy would *always* be to accumulate actual anticipated costs and bid this sum.<sup>2</sup> The SPSB method:

- eliminates the need to address uncertainties that surface when determining profit counter-strategies from competitors and,
- reduces administrative costs required in compiling data necessary in determining a competitive profit position.

Additionally, the SPSB method incentivizes contractors in becoming *more cost efficient*.

The lower they are able to reduce costs, the higher their chances in winning a contract.

Accordingly, price analysis and audits performed by the Government that are used in determining price reasonableness would, in theory, be lessened. In a competitive environment, free market forces between competing offerors would cause contractors to disclose their actual costs as reflected in their respective bid amounts.

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<sup>2</sup> The alternative of a buy-in strategy (i.e., the case where a contractor sets a bid price below his actual cost) to win an award may also be considered an element to a long-term strategy which will be discussed in further detail in this thesis.

In exploring the SPSB method, this thesis analyzes its perceived benefits to Government contracting as it pertains to reductions in resources necessary in performing the procurement process (e.g., reductions in the Procurement Administrative Lead Time (PALT))<sup>3</sup>. As revealed in this thesis, a “carefully” structured analytical approach into the application of the SPSB Method is presented through 1) controlled experimentation, and 2) surveying of private industry and Government contracting activities.

In short, the ultimate goal of this thesis is to contribute to acquisition reform through the exploration of alternatives in current Government contracting practices. Accordingly, this thesis highlights possible benefits and provides recommendations regarding the application of the SPSB method in Government contracting that may result in improving/refining long-run procurement efficiencies for DoD.

## **B. RESEARCH QUESTIONS**

The primary research question for this thesis is as follows:

Should the SPSB method be applied in the solicitation of Government contracts?

The following are the subsidiary research questions:

- What is the SPSB method as it pertains to Government contracting?
- Why should the SPSB method be adopted by DoD?
- Would the SPSB method be an accepted form of solicitation of contracts by Government and/or private industry?
- What impediments exist that would preclude the application of the SPSB method in Government contracting?

## **C. RESEARCH METHOD**

Information used in the preparation of this thesis was obtained through three primary methods; literature search, controlled experimentation, and surveying of both private industry and Government contracting professionals.

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<sup>3</sup> In general, PALT refers to the administrative time required by contracting offices to conduct a procurement request. [Ref. 3, p. 135]

A literature search was conducted to obtain a comprehensive understanding of the second price economic theory that forms the basis for the application of the SPSB method in Government contracting. The compilation of literature materials resulted from the use of library catalogs and periodical index guides, in addition to referrals from various contracting and economic professionals interviewed. Books, periodicals, and various other publications that are pertinent to the nucleus of the author's research are found in the List of References.

Controlled experimentation was conducted on 102 graduate students enrolled in various Systems Management curricula at the Naval Postgraduate School, Monterey, CA. Their assistance was solicited in providing a basis for determining behavioral trends as they pertain to the application of the SPSB method.

Mail surveys were offered to 28 private manufacturers and 73 Government contract commands and agencies. These surveys were sent primarily to determine if Government and/or private industry contracting communities understand and support the SPSB method. A list of those surveyed is found in Appendix A. Additionally, a sample of the survey can be found in Appendix B.

#### **D. SCOPE OF THESIS RESEARCH**

The thesis research is limited to the application of the SPSB method as it pertains to DoD contracting for services and materials under \$100,000. However, additional inferences may be extrapolated from this research that are applicable to *any* sealed bid FFP type contract, regardless of monetary amount. As such, it is expected that much of the research presented in this thesis is pertinent to both private and Government contracting entities engaged in sealed bid FFP type contracting.

#### **E. ORGANIZATION OF STUDY**

In Chapter II, an historical background for understanding the second-price method of handling sealed bids in an auctioning forum is presented followed by a detailed discussion of how the second-price mechanism is applicable to sealed bid solicitations used in Government contracting. This chapter further explores how the SPSB method provides incentives for revealing actual (truthful) costs from contractors and provide the advantages for its use.



In Chapter III, behavioral experimentation on the SPSB mechanism and the analysis of results is presented. This chapter describes the methodology and conditions in which the experiment was conducted. Analysis is then offered followed by discussion that examines the SPSB method as it applies to Government contracting.

In Chapter IV, survey results are analyzed and discussed in detail. This chapter presents a listing of survey questions asked and provide analysis and discussion on the responses offered. This area of research focuses on those perceptions offered from Government and private industry regarding the applicability/non-applicability of the SPSB method in Government contracting.

In Chapter V, conclusions and recommendations are provided. This chapter addresses each of the primary and subsidiary questions posed in Chapter I, and provides concluding remarks addressing whether the SPSB method is recommended for use in Government contracting. Additionally, suggest areas for further research are also listed in this chapter.

## F. DEFINITIONS

**Contractor (bidder)** - As used throughout this thesis, contractor (bidder) refers to a prospective contractor from private industry that is considered a *responsive* and *responsible* source, where 1) a *responsive* source refers to an offeror having the ability to adhere to the specifications, quantities to be delivered, schedule, and numerous terms and conditions found in the contract and, 2) a *responsible* source, in accordance with section 2731(8) of the Competition in Contracting Act (CICA) of 1984 (Public Law 98-369), describes a contractor that,

- has adequate financial resources to perform the contract or the ability to obtain such resources;
- is able to comply with the required or proposed delivery or performance schedule, taking into consideration all existing commercial and Government business commitments;
- has a satisfactory performance record;
- has a satisfactory record of integrity and business ethics;
- has the necessary organization, experience, accounting and operations controls, and technical skills, or the ability to obtain such organization, experience, controls, and skills;

- has the necessary production, construction, or technical equipment and facilities; and
- is otherwise qualified and eligible to receive an award under applicable laws and regulations. [Ref. 3, p. 247]

**Firm-Fixed Price (FFP) type contract** - As the name implies, the FFP type contract represents an agreement by the contractor to furnish designated supplies or services at a specified price which is not subject to adjustment in light of performance or costs. In its basic form, the FFP contract carries the greatest risk to the contractor and offers the greatest possibility of profit or loss of any type contract, since the contractor cannot collect more than the agreed fixed price but is entitled to receive the full amount of the fixed price, regardless of the actual cost of performing the contract. This type of contract is preferred whenever a sound estimate of the cost of performing a contract can be made. Since it is fundamentally a simple exchange of a specified sum of money for a specified item, it is the easiest and least costly of all types of contracts to administer. [Ref. 4, p.100]

**Price analysis** - Price analysis is defined as the examination of a contractor's price proposal (bid) by comparison with "reasonable price benchmarks, without examination and evaluation of the separate elements of cost and profit making up the price." In conducting price analysis, four methods are available: (1) analysis of competitive price proposals; (2) comparison with catalog or market prices; (3) comparison with historical prices; and (4) use of independent cost estimates. [Ref. 5, p. 253]

## II. BACKGROUND

It is easily shown that the required procedure is to ask for bids on the understanding that the award will be made to the highest bidder, but on the basis the price set by the second highest bidder. If this procedure is carried out, then the optimal strategy for each bidder (assuming the absence of collusion among bidders) will obviously be to make his bid equal to the full value of the article or contract to himself, i.e., to the highest amount he could afford to pay without incurring a net loss or to that price at which he would be on the margin of indifference as to whether he obtains the article or not. Bidding less than this full value could then only diminish his chances of winning at what would have been profitable, or at least not unprofitable, price and could not, collusion aside, affect the price he would actually pay if he were the successful bidder. Bidding more than full value, on the other hand, would increase his chances of winning, but only under circumstances that would involve him in an unprofitable transaction, the price to be paid being greater than his value. [Ref. 2, pp. 20-21]

With this statement, the economist William Vickery introduced "second-pricing." Although first introduced in 1961, the second-pricing theory is, for the most part, unknown throughout Government and private industry. Extrapolating from the second-pricing theory, this thesis develops the Second Price Sealed Bid (SPSB) method. This chapter 1) gives an historical sketch of auctioning and sealed bidding, 2) describes how sealed bidding is applied in Government contracting, and 3) provides an analytical presentation of the SPSB method and mechanisms that provide advantages for its application.

### A. THE HISTORICAL PERSPECTIVE OF AUCTIONING

Organized auctioning, from which sealed bidding evolved, found its early roots in the annual Babylonian marriage market where men sought to bid "no small sum" for the "loveliest maidens." Auctions were used to dispose of mine concessions in ancient Greece and were routinely used in Roman times to raise funds by selling confiscated property. As such, auctioning was the earliest of mechanisms used by governments to dispose of surplus property. The word "Auction" is a derivative of three Latin words "auctio," "encan," and "subasta" which are defined as "an increase," "I cry," and "under spear," respectfully. "Roman soldiers would auction off surplus spoils of war on the battlefield by driving a spear into the ground and selling off the booty gathered round it to the highest bidder." In 10 A.D., the Roman Government

auctioned rights to its state revenues to the highest bidder which relieved the Government from collecting. During this time it was also customary for debtors' property to be confiscated and sold at auction. [Ref. 6, pp. 39-41]

Following the fall of the Roman Empire and before the seventeenth century, few auctions were held because of the "small size of the population and the small quantity of circulating coinage." Although auctioning was not well accepted in the Orient, its use rapidly grew with the economic development in the West.

Auctions, as a method of selling, have only appeared in the comparatively civilized societies after the necessary conditions for their existence were fulfilled: an adequate concentration of the population to provide the sufficient number of buyers and sellers, and a coinage so that values of bids could be determined quickly. Thus, before the seventeenth century there were few regularly scheduled auctions sales. [Ref. 6, pp. 38-39]

The beginning of the seventeenth century saw the introduction of the four basic methods in auctioning: auctions using a hammer (the method that is commonly used in modern times), the hourglass, the candle, and the Dutch auction. Both hourglass and candle auctions allowed bidders a limited time for bidding and required an acute skill in timing as reflected by Peys in his diary dated 6 November 1660:

To our office, where we all met, for the sale of two ships by an ince of candle (the first time that I ever saw any of this kind), where I observed how they do invite one another, and at last how they all do cry, and we have much to do to tell who did cry last. The ships were the Indian, sold for £1300, and the Halfmoon, sold for £830. After dinner we met and sold the Weymouth, Success, and Fellowship hulks; where pleasant to see how backward men are first to bid, and yet when the candle is going out, how they bawl and dispute afterwards who bid the most first. And here I observed one man cunninger than the rest, that was sure to bid the last man, and to carry it; and enquiring the reason, he told me that, just as the flame goes out, the smoke descends, which is a thing I never observed before, and by that he do know the instant when to bid last. [Ref. 6, p. 46]

As the popularity of auctions grew, so did a bad reputation for dishonest practices which ushered in the Select Societies of Auctioneers in 1799. Established in England, the Society was formed to institute an honorable means of auctioning by providing training that made the practice a respectable occupation. As of 1983, the Select Society of Auctioneers still existed, however, in

token form only. Since the 1800s, institutions such as the Auctioneers' and Estates Agents Institute of the United Kingdom and the French Auction Centre Hotel Drouot began to flourish. In the United States organized auctioning became widely accepted. In the 1960s, for example, there existed between 20,000 and 35,000 auctioneers and approximately 1900 wholesale auctions selling around \$3.4 billion per year. [Ref. 6, pp. 46-50]

As a variant of the auction, sealed bidding was believed to have its origins at a considerably later date than the first auctioning used during the Babylonian period. [Ref. 7, p. 35] With the growth in Federal and State Government, sealed bidding became widely accepted in the acquisition of large items such as transformers, steam turbines, ships, aircraft, and tanks. Currently, the Government, and especially DoD, routinely uses sealed bidding in the acquisition of everything from pencils to major weapon systems. [Ref. 6, p. 50]

## **B. SEALED BIDDING AND GOVERNMENT CONTRACTING**

Similar to an auction, sealed bidding, as used in the contracting arena, is a technique of *price-directed sourcing* where award of a contract is based primarily on the lowest bid price offered. Both auction bidding and sealed bidding offer the capability for bidding in an open (public) forum which provide interested contractors the opportunity to compete equally for a contract. To ensure fairness and equality, "house" rules are provided that govern bid acceptance. The two bidding methods differ in that sealed bidding is believed to generate bid prices that reflect the *reasonable cost of performance* while auctioning generates bid prices that reflect *current subjective values* (vice cost). Additionally, "sealed bidding allows only *one bid*, whereas with auction bidding, repetitive competitive bids are sought." [Ref. 3, p.238] Evolving through years of political and legal debate, sealed bidding has become a preferred method of procurement in Government contracting. Consequently, sealed bidding has become widely accepted in contracting for services and materials where price is the primary criteria in determining award of a contract. [Ref. 6, pp. 49-50]

As documented by Stanley N. Sherman, the criteria for considering and using sealed bidding in Government procurement includes the following:

1. There will be *more than one qualified supplier* willing to compete for and to perform the proposed contract.
2. The requirement is adequately defined to allow competitors to bid for the *procurement on an equal basis*.

3. *Sufficient time* is available to allow the purchase to be accomplished through an orderly solicitation and award process.
4. *Price can be used as an adequate basis* for determining the source to be awarded the contract. [Ref. 3, p. 241]

Accordingly, sealed bidding in Government contracting is rigidly structured, where each step in the process is carefully executed to ensure equitable treatment of bidders while allowing the Government to make an award in a consistent and logical manner. Additionally, when applied by the Government, the Federal Acquisition Regulation (FAR) requires that, “**only *firm-fixed type contracts* shall be used when the method of contracting is sealed bidding...**” [Ref. 8, p. 14-1]

As further delineated in FAR Part 14, there are five basic steps in sealed bidding:

- (a) *Preparation of invitation for bids.* Invitations must describe the requirements of the Government clearly, accurately, and completely. Unnecessary restrictive specifications or requirements that might unduly limit the number of bidders are prohibited...
- (b) *Publicizing the invitation for bids.* Invitations must be publicized through distribution of prospective bidders, posting in public places, and such other means as may be appropriate. Publicizing must occur a sufficient time before public opening of bids to enable prospective bidders to prepare and submit bids.
- (c) *Submission of bids.* Bidders must submit sealed bids to be opened at the time and place stated in the solicitation for the public opening of bids.
- (d) *Evaluation of bids.* Bids shall be evaluated without discussion [with bidders].
- (e) *Contract award.* After bids are publicly opened, an award will be made with a reasonable promptness to that bidder whose bid, conforming to the invitation for bids, will be most advantageous to the Government, considering only price and price-related factors included in the invitation. [Ref. 8, p.14-1]

In summary, after a requirement is generated and all the elements necessary in sealed bidding are present (i.e., the four criteria cited above by Sherman), then,

1. a sealed bid solicitation for an FFP type contract is prepared and publicly announced through various methods (i.e., displaying in public places, mailing or delivery to prospective contractors, or advertising in newspapers, trade journals or Government publications such as the Commerce Business Daily),
2. bids are prepared and received from prospective contractors and held, unopened, by the Government,

3. bids are then opened by Government officials in a public forum at an appointed time as specified in the solicitation for bid (at this time all contractors and their respective bids are publicly known),
4. and award is made to the responsible contractor whose bid is considered most advantageous to the Government (i.e., the contractor that reflects the lowest price and can accomplish the requirements of the solicitation is awarded the contract).

The only variation to the steps described above involves the two-step sealed bidding method. This method is used when technical clarification is required to refine specifications contained in the solicitation. This two-step procedure is described as follows:

- (a) Step one consists of the request for, submission, evaluation, and (if necessary) discussion of a technical proposal. No pricing is involved. The objective is to determine the acceptability of the supplies or services offered... Conformity to technical requirements is resolved in this step...
- (b) Step two involves the submission of sealed price bids by those who submitted acceptable technical proposals in step one. Bids submitted in step two are evaluated and the awards made... [Ref. 8, p. 14-20]

Accordingly, sealed bidding in Government contracting is a very formal process that employs competition in a public forum that ultimately results in award being made equitably to the lowest bid submitted that is most advantageous to the Government. This thesis will now explore the theory of the SPSB method.

### C. THE BASIC THEORY OF THE SPSB METHOD

For any given requirement, the buyer, i.e., the Government, wants a method of bidding that maximizes its utility while minimizing associated expenditures. The Government's desired utilities for a contracted item may be characterized as being the fastest, highest, smallest, most efficient, most powerful, and so forth. Expenditures, on the other hand, are those resources consumed in the process of attaining these desired utilities. Such resources would, for example, include dollars, manpower, and materials. Obtaining the above utilities while *minimizing expenditures* is the underlying theme from which this thesis is drafted. More specifically, a bidding method that meets the Government's requirements (utilities) while minimizing expenditures is desired. Therefore, this thesis turns its attention to the SPSB method to

understand its theoretical implications as it pertains to minimizing resource expenditures in the acquisition process.

Extrapolating from the second-pricing theory provided by Mr. Edi Karni (John Hopkins University) and Mr. Zvi Safra (Tel-Aviv University) this thesis proposes the following SPSB theory. [Ref. 9, pp. 420-433] When considering the SPSB method, it is assumed that competing contractors want to maximize their chances of winning profitable contracts. Given any contract, let  $bp$  and  $tc$  denote, respectively, the bid price and the true cost associated in performing the contract.<sup>4</sup> And further suppose that a contractor's  $bp < tc$ . Clearly, if the lowest bid of the other contractors is less than  $bp$  then the given contractor loses whether he bids  $bp$  or  $tc$ . If the lowest bid of the other contractors is greater than  $tc$ , then he wins whether he bids  $bp$  or  $tc$ . Thus, bidding a price lower than  $tc$  makes a difference only of the lowest bid of the other contractors is between  $bp$  and  $tc$ . However, in this case the contractor wins the contract for a price that is less than his true cost, which is not optimal. Thus,  $bp$  must not be less than  $tc$ . Bidding a price,  $bp$ , higher than  $tc$  is similarly not optimal. For if other contractors bid lower than  $bp$ , yet higher than  $tc$ , the contractor loses the award and earns nothing. Consequently, regardless of the behavior of the other contractors, bidding a contractor's true cost constitutes the dominant strategy in the SPSB method.

To provide a less sophisticated theoretical description of the SPSB method, the following contract bidding scenarios describe how alternative pricing strategies generate the dominant, or optimal, SPSB pricing strategy for contractors. As shown below, Table 1 represents a bid schedule where,

- **Contractor** represents interested contractors bidding in response to a SPSB solicitation for a Government FFP type contract for products or services.
- **Bid Amount** represents the corresponding contractor's bid price for the solicited contract.

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<sup>4</sup> To extrapolate from William Vickrey's second-pricing theory, the true cost,  $tc$ , represents a bidder's total cost to perform a contract, which *includes* a bidder's *margin of profit* that is normally determined through a corporate profit policy. Additionally, included in  $tc$  is a contractor's *opportunity cost of profit* (e.g., a bidder may bid below  $tc$ , thereby foregoing profit to increase the chance of winning an award). [Ref. 2, p. 20]



- **True Cost (Actual Cost)** represents the corresponding contractor's actual anticipated cost to perform a contract. As such, true cost is a total cost which includes *all* direct and indirect costs (as well as the *margin of profit, or cost of profit*, as suggested by William Vickerey). [Ref. 2, p.20]

Contractor	Bid Amount	Actual Cost
A	\$25,500	\$25,000
B	\$26,000	\$24,000
C	\$27,000	\$26,000

Table 1. Bid schedule.

In the above table, Contractors A, B, and C are competing for a Government contract where, for example, Contractor C has submitted a bid price of \$27,000 with a corresponding true cost to perform the contract of \$26,000.

In applying the First Price Sealed Bid (FPSB) method to the Bid schedule in Table 1, the contractor having the lowest bid price wins the award and is paid their corresponding bid price. Therefore, Contractor A would win the award and be paid \$25,500. The profit earnings in this scenario would be:

$$\begin{aligned}
 \text{Profit} &= \text{FPSB award price (Contractor A's bid price)} - \text{Contractor A's true cost} \\
 &= \$25,500 - 25,000 \\
 &= \$500
 \end{aligned}$$

When we consider applying the SPSB method, the contractor submitting the lowest bid price wins the award, however, in contrast to the FPSB method, is paid *the next lowest bid price*. Referring to Table 1, Contractor A would win the award and be paid the next lowest bid price of \$26,000 which was submitted by Contractor B. In this case, Contractor A would realize a profit of \$1,000 which is calculated below:

$$\begin{aligned}
 \text{Profit} &= \text{SPSB award price (Contractor B's bid price)} - \text{Contractor A's true cost} \\
 &= \$26,000 - 25,000 \\
 &= \$1,000
 \end{aligned}$$

### 1. Bid Price Equals True Cost

Under the SPSB method, a contractor's best pricing strategy for winning an award is to submit the lowest possible bid price in the competition that will also return a profit. However, determining where the best bid price should be set becomes a dilemma. For example, in setting a bid price below a contractor's true cost *increases* the chance of winning the award, however, concurrently *increases* the chance of winning the award in an *unprofitable position*. Conversely, setting a bid price higher than true cost increases the chance of losing the award to a competitor. In addressing this dilemma in further detail, consider Table 2.

Contractor	Bid Amount	Actual Cost
A	\$25,000	\$25,000
B	\$24,000	\$24,000
C	\$26,000	\$26,000

Table 2. Bid price equals true cost.

In this table it is assumed that all contractors behave *rationally*. As such, each contractor assumes their most competitive position by setting their bid price equal to their true cost. As a *rational contractor*, they know that winning the award under this scenario will guarantee a profit equal to the difference between the next lowest bid price and their true cost. Invoking the SPSB method to the scenario presented in Table 2, Contractor B would be awarded the contract and be paid the next lowest bid price as set by Contractor A. Contractor B's profit would be calculated as follows:

$$\begin{aligned}\text{Profit} &= \text{SPSB award price (Contractor A's bid price)} - \text{Contractor B's true cost} \\ &= \$25,000 - 24,000 \\ &= \$1,000\end{aligned}$$

In contrast to the SPSB award scenario described in Table 1<sup>5</sup>, award in Table 2 went to the most *cost efficient contractor* (i.e., award was given to the contractor who could perform the contract at the least cost; Contractor B's true cost < Contractor A's true cost  $\Rightarrow$  Contractor B is

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<sup>5</sup> You may recall that the contractors' bid prices reflected in Table 1 were all higher than their respective true costs (i.e.,  $bp > ac$ ).

considered more cost efficient). Therefore, where rational contractors submit a bid price equal to their true cost, then contract award goes to the most cost efficient contractor.

## 2. Bid Price Above True Cost

Suppose, as shown in table 3, that Contractor B bids higher than his true cost.

Contractor	Bid Amount	Actual Cost
A	\$25,000	\$25,000
B	\$26,000	\$24,000
C	\$26,000	\$26,000

Table 3. Bid price above true cost.

Accordingly, Contractor B loses award to the lowest bid price offered by Contractor A. Had Contractor B bid his true cost, he would have been awarded the contract and is paid \$1,000 profit. However, in the scenario above, he has earned *nothing*.

Given this scenario, one can then say that as a contractor incrementally raises his bid price above his true cost, he unnecessarily *increases* the risk of losing an award to a competitor. As applied to Table 3, Contractor B has acted *irrationally* and gained nothing by raising his bid price above his true cost. Hence:

**Under the SPSB method, contractors bidding higher than their true cost act irrationally because they increase the risk of losing an award, thereby diminishing the chance of earning any sum of profit.**

## 3. Bid Price Below True Cost

Now consider the case where Contractor B's bid price is lower than his true cost in hopes of increasing the chance of winning the award. This is reflected in Table 4 below.

Contractor	Bid Amount	Actual Cost
A	\$25,000	\$25,000
B	\$23,000	\$24,000
C	\$26,000	\$26,000

Table 4. Bid price below true cost.

Under this scenario, Contractor B would have won award and earned \$1,000 profit as calculated below:

$$\begin{aligned}\text{Profit} &= \text{SPSB award price (Contractor A's bid price)} - \text{Contractor B's true cost} \\ &= \$25,000 - 24,000 \\ &= \$1,000\end{aligned}$$

In this situation, Contractor A may believe he can improve the chances of winning the award by offering a bid price far below his true cost and still realize a \$1,000 profit. In fact, Contractor A would realize this profit if he were to bid *one dollar*. However, if another contractor offers a bid price below Contractor B's true cost, then Contractor B would win the award in an unprofitable position. This case is shown below in Table 5.

Contractor	Bid Amount	Actual Cost
A	\$25,000	\$25,000
B	\$1	\$24,000
C	\$23,000	\$23,000

Table 5. Bid below true cost.

In accordance with the SPSB method, Contractor B would win the award and be paid a price of \$23,000 (Contractor C's bid price), which is below his true cost of \$24,000. Accordingly, his loss would be calculated as follows:

$$\begin{aligned}\text{Loss} &= \text{SPSB award price (Contractor C's bid price)} - \text{Contractor B's true cost} \\ &= \$23,000 - 24,000 \\ &= -\$1,000\end{aligned}$$

In this case it is shown that bidding below one's true cost is *irrational*. Given this scenario, one can conclude that as a contractor incrementally *lowers* his bid price below his true cost, he concurrently increases the risk of winning the award in an *unprofitable position*. Hence,

**Under the SPSB method, contractors bidding lower than their true cost act irrationally because they increase the chance of winning an award in an unprofitable position.**

#### 4. The Case Where Lowest Bid Prices are Equal

The final scenario addresses the case where Contractor A's bid price is the lowest, however, is equal to another bidder's price. This is shown in Table 6.

Contractor	Bid Amount	Actual Cost
A	\$25,000	\$25,000
B	\$25,000	\$25,000
C	\$27,000	\$26,000

Table 6. Lowest bid is equal between competitors.

Accordingly, Contractors A and B show a bid price of \$25,000 which represents the lowest bid price. Under these circumstances we must determine who wins the award and at what bid price is the awardee paid. Ideally, tie-breaking provisions in the solicitation would address this situation. One suggested alternative is splitting the contract between the lowest bidders and paying both one-half of the next lowest bid price. This situation will be further analyzed and discussed in Chapters III and IV.

#### 5. A Summary of the SPSB Method

To summarize the above findings, it is shown that rational contractors are incentivized to set their bid price equal to their true cost. Bidding in this manner maximizes their opportunity to win an award in a profitable position. Acting irrationally, on the other hand, contractors will set their bid price above or below their true cost which only serves to diminish a contractor's chance of earning a sum of profit.

#### D. THEORETICAL ADVANTAGES OF THE SPSB METHOD

As described above, contractors' optimal pricing strategy when the SPSB method is applied is to bid their true cost. Theoretically then, advantages that result from this strategy would include the following:

- Costly and time intensive Government administrative requirements (e.g., various administrative requirements involved in PALT) would be eliminated. As a prime example, by knowing what contractors' true costs are (where bid prices are set to true

costs), market surveys used in determining price reasonableness would become unnecessary.

- The most cost efficient contractor will always win the award. The Government is assured that the contractor receiving the award exercises the most cost efficient practices relative to its competitors.
- Contractors are incentivized to expedite implementation of cost efficient practices. The quicker a contractor can lower the cost of performance, the greater the profits that will be earned because the winning contractor will continue be paid the next lowest bid price.
- Contractors are spared the additional time and expense necessary in compiling profit data necessary in developing a competitive bid price. Under the SPSB method, bid prices will *always* be set equal to the true costs.
- Competition may be stimulated. The simplicity in bid price setting (i.e., setting bid price equal to true cost) may attract prospective contractors in engaging in business with the Government.

In short, the founder of the second-pricing theory, Mr. William Vickery, made a statement regarding its advantages:

It is one of the salient advantages of the second-price method that it makes any such general market appraisal entirely superfluous, whether considered from the standpoint of individual gain or from that of the over-all allocation of resources. Each bidder can confine his efforts and attention to an appraisal of the article [contract] would have in his own hands, at a considerable saving in mental strain and possibly out of pocket expense. In the first instance this saving might redound largely to the benefit of the bidders; as a corollary, however, more bidders might be induced to put in bids, resulting in a better allocation of resources... [Ref. 2, p. 22]

Throughout the remainder of this thesis, this thesis analyzes the plausibility concerning these advantages and discusses their applicability in the "real world."

## **E. SUMMARY**

Historically, this thesis has shown the emergence of auctioning and sealed bidding. Despite a bad reputation in the 1700s, they have become a mainstay in today's market place. In

the 1900s sealed bidding became popular in Government procurement. As such, a description was provided regarding the application of the sealed bidding method in Government contracting. As one forges into the 21<sup>st</sup> Century, innovative theories and methods, such as SPSB, are being introduced as tools to more efficiently allocate resources. Hence, this chapter provided the theory of the SPSB method and explained how the optimal pricing strategy is beneficial for both Government and private industry. Despite these advantages, its application within the Government contracting arena (and, for the most part, private industry) has neither been tested or applied. The following chapter presents the results of two SPSB experiments which will provide insight into the SPSB mechanisms.





### III. EXPERIMENTATION WITH THE FPSB/SPSB METHOD

This chapter will, through two sets of experimentation, 1) highlight behavior changes that exist when shifting from the First Price Sealed Bid (FPSB) method to the Second Price Sealed Bid (SPSB) method as used in the context of Government contracting, and 2) identify pricing trends found in the second-price *auctioning* mechanism and apply these trends to the SPSB method.

This chapter will begin by describing the methodology and conditions in which the first set of four independent SPSB experiments were conducted. The results of each experiment are then compared and analyzed. Then, a second set of experiments that reveal pricing trends used in the second-price *auction mechanism* is analyzed. From these trends, inferences regarding their application to the SPSB method are identified. The final section of this chapter will then provide concluding observations concerning behavioral changes and expected pricing trends as they pertain to the SPSB method.

#### A. EXPERIMENTATION WITH THE FPSB AND SPSB METHODS

##### 1. The Setting for Experimentation

To accomplish experimentation of the FPSB and SPSB methods, four independent classroom experiments which involved 102 graduate students were conducted.<sup>6</sup> Thirty-four groups were formed from the 102 students and each group represented a contractor competing for award of a Government FFP type contract. Each of the four experiments consisted of two phases. As reflected in Appendix C, Phase I of Experiment 1 requested each group to 1) provide a bid price for the manufacture of ten infrared sensors under the terms of the FPSB method, and 2) provide a bid price for the manufacture of ten microprocessors under the terms of the SPSB method. In formulating their bid prices, *each* group was provided:

- a unique "true" cost in manufacturing ten sensors<sup>7</sup>,

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<sup>6</sup> All 102 graduate students were attending studies at the Navy Postgraduate School, Monterey, California.

<sup>7</sup> "True" cost is defined as the actual total cost incurred by a contractor to manufacture an item. Accordingly, this would include *all* direct and indirect costs, *less profit*.

- the industry-wide average cost to manufacture ten sensors,
- the industry-wide average profit rate of eight-percent.

For example, in Phase 1 of Experiment 1 each of the eleven groups were provided a cost that was within the range of \$900 to \$1,100, informed that the industry-wide average cost to manufacture ten sensors was \$1,000, and that the industry-wide profit rate was 8-percent. This is reflected in Table 7 below.

<b>Experiment 1, Phase I</b>					
<b>Industry Average Cost = \$1,000</b>					
<b>Industry Average Profit = 8%</b>					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	1,095	1,095	0.00%	1,095	0.00%
2	907	957	5.51%	907	0.00%
3	1,078	1,080	0.19%	1,020	-5.38%
4	1,070	1,070	0.00%	1,070	0.00%
5	1,091	1,178	7.97%	1,145	4.95%
6	966	1,040	7.66%	1,010	4.55%
7	1,036	1,060	2.32%	1,036	0.00%
8	907	960	5.84%	940	3.64%
9	1,043	1,075	3.07%	1,070	2.59%
10	1,025	1,075	4.88%	1,074	4.78%
11	947	1,004	6.00%	947	0.00%

Table 7. Results from Experiment 1, Phases I.

In determining “cost” values unique to each group, the Microsoft Excel Random Number Generator (Version 5.0) was applied which produced the distribution of costs found in the “Cost” column in Table 7.<sup>8</sup> The formulation of these cost values were derived from a uniform-distribution having a plus/minus ten-percent factor from the mean-cost-value. Given the above information, each group was requested to formulate their bid price.

<sup>8</sup> Appendix D provides a full listing of Microsoft Excel randomly generated “Cost” values assigned in Tables 7 through 11.

To provide additional clarification to Table 7, the columns "1st Price" and "2nd Price" refer to each groups' bid prices under the FPSB and SPSB methods, respectfully. The "% Change" column represents the percent difference between each groups' FPSB and SPSB price and their true cost. For example, Group 11 shows a six-percent FPSB price increase above their true cost and a zero-percent change between their SPSB price and their true cost.

Similar to Phase I, Phase II requested each group to submit two bid prices to manufacture a complex microprocessor under the terms of the FPSB and SPSB method, respectfully. In formulating their bid prices, *each* group was provided:

- a unique "true" cost in manufacturing ten microprocessors,
- the industry-wide average profit rate of twelve-percent (vice eight-percent as used in Phase 1).

Because the technology to manufacture the microprocessors was considered state-of-the-art, no industry-wide average cost was available.

Prior to conducting each of the four experiments, all groups were provided a full description of the FPSB and SPSB methods. Accordingly, definitions were provided to each group as follows:

- **First Price Sealed Bid** - Award goes to the lowest bidder and is paid the amount of their bid.
- **Second Price Sealed Bid** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

To provide further clarification, each group was informed that 1) the economy was assumed to be steadily growing, 2) that "learning-curve" cost efficiencies did not pertain<sup>9</sup>, 3) that each group had their own unique cost (i.e., that the chances of any two groups having the same cost is remote), and 3) each group must formulate their pricing strategies independently (i.e., there was to be no sharing of information between groups).

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<sup>9</sup> The "learning-curve" concept suggests that during the production life of an item, unit costs decrease due to improved production efficiencies.

## 2. Experiment 1 - A Shift from the FPSB Method to SPSB Method

As shown in Appendix C, Phases I and II of Experiment 1 requested each of the eleven participating groups to provide a FPSB and SPSB price in response to a Government solicitation for ten infrared sensors (Phase I) and ten microprocessors (Phase II). The results are shown below in Table 8.

<b>Experiment 1, Phase I</b>					
Industry Average Cost = \$1,000					
Industry Average Profit = 8%					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	1,095	1,095	0.00%	1,095	0.00%
2	907	957	5.51%	907	0.00%
3	1,078	1,080	0.19%	1,020	-5.38%
4	1,070	1,070	0.00%	1,070	0.00%
5	1,091	1,178	7.97%	1,145	4.95%
6	966	1,040	7.66%	1,010	4.55%
7	1,036	1,060	2.32%	1,036	0.00%
8	907	960	5.84%	940	3.64%
9	1,043	1,075	3.07%	1,070	2.59%
10	1,025	1,075	4.88%	1,074	4.78%
11	947	1,004	6.00%	947	0.00%
SPSB Winning Bidder - Group 2, Profit = 33					
<b>Experiment 1, Phase II</b>					
Industry Average Cost = none provided					
Industry Average Profit = 12%					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	9,557	10,131	6.01%	9,557	0.00%
2	10,300	11,705	13.64%	10,300	0.00%
3	8,658	9,524	10.00%	8,700	0.49%
4	9,305	10,235	9.99%	9,305	0.00%
5	9,176	9,634	4.99%	9,543	4.00%
6	8,039	8,840	9.96%	8,440	4.99%
7	8,827	9,268	5.00%	8,827	0.00%
8	10,602	11,662	10.00%	10,602	0.00%
9	8,239	9,063	10.00%	8,899	8.01%
10	11,645	13,392	15.00%	12,693	9.00%
11	10,867	11,736	8.00%	10,867	0.00%
SPSB Winning Bidder - Group 6, Profit = 661					

Table 8. Results from Experiment 1, Phases I & II.

*a. Experiment 1, Phase I*

In Phase I the industry-wide average cost was \$1,000 and the industry-wide profit rate was eight-percent. As reflected in Table 8, the predominant FPSB pricing strategy was to set bid prices between true cost and true cost-plus-eight-percent (the industry-wide profit rate). The rationale for this pricing strategy was to reflect a competitive bid price that was believed to be lower than the competition. Winning the award under this strategy, therefore, guaranteed *some* level of profit.

In contrast to the above strategy, two groups did set their FPSB price *equal* to their true costs. Because these groups has true costs that exceeded the industry-wide average cost of \$1,000, their strategy was to simply bid the lowest possible price that would "get their foot in the door" without losing money. Overall, the FPSB pricing strategies reflected in Table 8 are consistent with typical business pricing practices.

When shifting to the SPSB method, there is an overall reduction in bid prices as compared to those reflected under the FPSB method. Of the eleven groups, five groups (Groups 1, 2, 4, 7, and 11) chose to set their bid price *equal* to their true cost. This is reflected in the last column in Table 8 where the "% Change from Cost" equals "0.00%." The rationale for this pricing strategy included, "[We] bid our cost because if we're [the] lowest [bidder], we get paid at *some* profit level," "[If we bid at cost we're] guaranteed not to lose money," and "Since this is a second price solicitation, we thought that by bidding at cost we were assured of making *some* profit above our bid if we were selected." Accordingly, these groups acted rationally by correctly formulating the SPSB optimal pricing strategy discussed in Chapter II (i.e., to set one's bid price equal to their true cost). Group 3 chose to bid 5.38-percent *below* their true cost, believing that they would improve their chances of winning the contract. In choosing this strategy, Group 3 did increase the chance of winning the contract, however, they also *increased* their chance of winning in a loss position.

The remaining groups chose to continue with their original FPSB strategy of bidding above their true cost, yet lower than their cost-plus-eight-percent (the industry-wide profit rate). Under this strategy, they were guaranteed a profit if they won the award.

In analyzing the winning bidder, Group 2, it should be noted that applying the SPSB method resulted in choosing *the most cost efficient group*. This concurs with the

theoretical advantage of the SPSB method stated in Chapter II where the most cost efficient contractor is awarded a contract when the SPSB method is applied. Although the winning bidder maintained the optimal pricing strategy of bidding their true cost, this strategy was not as successful in winning awards in future experiments.

It is also interesting to note that both Groups 2 and 8 had an identical cost structure (i.e., both their true costs were \$907). If Group 8 would have bid their true cost, then there would have been a tie for the winning lowest bid. Had this occurred, a possible solution which was previously offered in Chapter II would have been to split the award equally, and pay each winner one-half of the next lowest bid price. In the above experiment, this would have resulted in Groups 2 and 8 being awarded a contract to produce five sensors each and paid one-half of the next lowest bid price of \$947 (Group 11's bid price). An alternative option would be to award the entire contract by means of a toss-of-the-coin or a draw. In this instance the winning group is chosen by the flip-of-a-coin or picking a "win" or "lose" card. The winning group is then awarded the entire contract. This situation will be discussed in further detail in this thesis.

#### *b. Experiment 1, Phase II*

In Phase II of Table 8, the industry-wide profit rate is twelve-percent, and, in contrast to Phase I, there is *no industry-wide average cost*. In selecting a FPSB pricing strategy, ten of the eleven groups all set bid prices between their true cost and true cost-plus-twelve-percent profit (where twelve-percent represents the industry-wide average profit rate). In remaining consistent with the general strategy reflected in Phase I, their FPSB pricing strategy was to lessen their profit below the industry-wide profit rate in order to submit a more competitive bid. The only exception, Group 10, set their bid price at cost-plus-fifteen-percent profit and stated the following rationale, "Since we're state-of-the-art (cutting edge) we should be able to get a [15]% profit." Unfortunately, this group totally disregarded the pricing strategies exercised by their competitors.

Similar to the results found in Phase I, introducing the SPSB method in Phase II was accompanied by *dramatically reduced bid prices* as compared to those bid prices found under the FPSB method. In fact, six of the eleven groups are reflecting the optimal pricing strategy by setting their bid prices equal to their true cost. The rationale for bidding in this

manner included, "Bid at cost with the knowledge that if we won the award at the next [lowest] price would ensure some profit" and "We're going to get the contract and still make a profit if [the] second to lowest bid is above our cost." The essence of these comments is in agreement with the SPSB optimal pricing theory that bidding at true cost maximizes the chances of each groups' opportunity to win an award in a profitable position.

As with Phase I, the remaining groups reflected bid prices above their true costs. Accordingly, they followed their same pricing strategy used under the FPSB method. Of note, in *both* Phases of Experiment I there was no cited reasoning as to why their SPSB prices were lower than their FPSB prices. It can only be speculated that the SPSB method was believed intensify competition, thereby causing each group to reflect bid prices that were *perceived* to be more competitive.

In contrast to the winning bidder in Phase I, the winning bidder in Phase II, Group 6, *did not* bid their true cost. Coincidentally, however, this group was also the most cost efficient group in Phase II. Consequently, Group 6 could have set their bid price equal to their true cost, or a price slightly below the next lowest bidder and still won the award. In short, one can conclude from Phase II that with the unavoidable element of uncertainty, *luck* will prevail in *isolated* instances where the winning bidder does *not* practice the optimal, or dominant, bidding strategy of setting their bid price equal their true cost.

### **3. Experiment 2 - A Shift from the FPSB Method to SPSB Method**

As shown in Appendix C, Phases I and II of Experiment 2 requested each of the nine participating groups to provide a FPSB and a SPSB price in response to a Government solicitation for ten infrared sensors (Phase I) and ten microprocessors (Phase II). The results are shown below in Table 9. (Note that Group 2 of Phase 2 was eliminated because they falsely applied a learning-curve effect in determining their bid price.)

<b>Experiment 2, Phase I</b>					
Industry Average Cost = \$10,000					
Industry Average Profit = 8%					
Group	Cost	% Change	Profit %	2nd Price	% Change
1	10,733	10,795	0.58%	10,700	-0.31%
2	10,398	10,400	0.02%	10,200	-1.90%
3	9,500	10,150	6.84%	10,059	5.88%
4	10,498	12,000	14.31%	10,500	0.02%
5	10,813	11,000	1.73%	11,000	1.73%
6	9,081	9,175	1.04%	<b>9,081</b>	<b>0.00%</b>
7	9,057	9,600	6.00%	9,510	5.00%
8	10,091	10,799	7.02%	10,400	3.06%
9	10,449	10,649	1.91%	10,400	-0.47%
<b>SPSB Winning Bidder - Group 6, Profit = 429</b>					
<b>Experiment 2, Phase II</b>					
Industry Average Cost = none provided					
Industry Average Profit = 12%					
Group	Cost	% Change	Profit %	2nd Price	% Change
1	3,659	3,952	8.01%	3,879	6.01%
2	-	-	-	-	-
3	5,916	6,500	9.87%	6,450	9.03%
4	3,733	4,070	9.03%	4,000	7.15%
5	3,456	3,456	0.00%	3,491	1.01%
6	5,293	5,399	2.00%	5,293	0.00%
7	3,150	3,465	10.00%	<b>3,402</b>	<b>8.00%</b>
8	4,827	5,310	10.01%	5,068	4.99%
9	4,425	4,825	9.04%	4,690	5.99%
<b>SPSB Winning Bidder, Group 7, Profit = 341</b>					

Table 9. Results from Experiment 2, Phases I & II.

*a. Experiment 2, Phase I*

In Phase 1 the industry-wide average cost was \$10,000 and the industry-wide profit rate was eight-percent. With one exception, the FPSB pricing strategy for each group was



to set bid prices between true costs and true cost-plus-eight-percent (where eight-percent is the industry-wide profit rate). In considering the industry-wide average cost of \$10,000, four of the nine groups having true costs above this amount were willing to earn below a two-percent profit in order to submit competitive bid prices. Despite having a true cost figure *above* the industry-wide average, Group 4 set their bid at 6.31-percentage points *above* the industry-wide profit rate. "[We] make money by taking risk...their [the competition's] cost might be higher than ours." Despite having a cost higher than the industry-wide average cost, they grossly erred in believing that the competition's costs were higher than theirs.

When applying the SPSB method, it is noted that the same phenomena as experienced in Experiment 1 where there was an overall *downward pricing trend* when shifting from the FPSB method to the SPSB method. In Phase I of Experiment 2, however, three of the groups chose to set their bid prices slightly *below* their true costs. In setting their bid prices in this manner, they hoped "to get [be awarded] someone else's price to make a profit." The strategy observed here is to set the bid price *slightly below* one's true cost and chancing that the next lowest bid price is above this amount. Although this strategy increases the chance of winning the award, groups acting in this manner must acknowledge an opportunity trade-off. In assuming this type of risk, these groups should be willing to operate at a loss if awarded the contract and paid a next lowest bid price *below* their true cost. Furthermore, a group's long-term strategy may include such a short-term buy-in tactic (i.e., bidding a price below one's true cost to win award in hopes of follow-on profitable contracts). This is a commonly practiced pricing strategy used in real-world scenarios and is practiced when contractors are attempting to "get their foot into the door" in hopes of attracting future contracts with the Government. Contractors will also submit a buy-in bid price as a means of company survival. In either case, contractors are willing to operate at a loss in the short-term to improve their cash flow, thereby chancing that future opportunities will compensate their short-term losses. Obviously, this is a risky endeavor that must carefully be analyzed with respect to a contractor's capability to perform.

In setting a bid price *slightly below* one's true cost, however, may prove to be a variant optimal bidding strategy when the level of such under-bidding is *less* than the prospective cost differentials between the two lowest bidders. In this scenario, however, this will not change who will become the winning bidder. The lowest cost producer will *always* win the award

among the *experienced* (knowledgeable) bidders. In addition, if the level of under-bidding is equal to the cost differential between the two lowest bidders, then the nature of the tie-breaking provision becomes important. For example, if the provision entails awarding the next lowest price (i.e., the third lowest price) rather than the tied lowest bid price, then under-bidding will be the optimal strategy. Conversely, if the tie-breaking provision calls for awarding the tied lowest bid price, then the dominate strategy is to bid one's true cost. To the extent the subjects of these experiments view the cost differentials to be greater than a penny, it is not surprising to see them bidding a penny lower (i.e., the smallest denomination of currency) than their true cost.

Group 4's bid of \$10,500, *which is only two dollars above than their true cost*, represents a near-optimal pricing strategy. Although they cited that this bid price "just covers total cost, but still makes money," their strategy would have been flawed had another group bid \$10,499. If this would have happened, group four would have certainly lost the award. In fact, a similar situation is represented by the bid prices provided by Groups 6 and 7. Notice that Group 7 has the lowest true cost of \$9,057, but bid a price of \$9,510. On the other hand, Group 6's bid price of \$9,081 was equal to their true cost, which resulted in winning the award. In accordance with the SPSB payment schedule, they were paid \$9,510 which was, coincidentally, Group 7's bid price. Had Group 7 bid a price equal to their true cost, they would have won the award. Bidding above their true cost resulted in losing the award. Therefore, the theory of bidding *above* one's true cost is irrational as earlier stated in Chapter II:

**Under the SPSB method, contractors bidding higher than their true cost act irrationally because they increase the risk of losing an award, thereby diminishing the chance of earning any sum of profit.**

The remaining three groups, Groups 3, 5, 7, and 8, continued with their original FPSB pricing strategy of setting SPSB prices between their true costs and true cost-plus-the-industry-wide profit rate.

#### ***b. Experiment 2, Phase II***

Identical to Phase II of Experiment 1, the industry-wide profit rate in Phase II of Experiment 2 was twelve-percent and no industry-wide average cost was provided. As observed in the three previous phases, bid prices offered under the SPSB method were, with few exceptions, *consistently* lower than bid prices offered under the FPSB method. In observing one

of the exceptions, Group 5's bid price actually *increased* when shifting from the FPSB method to the SPSB method. Accordingly, under the FPSB method, they set their FPSB price *equal* to their true cost and subsequently *raised* their price (above their true cost) when competing under the terms of the SPSB method. As stated in their rationale, Group 5 set their SPSB price at \$3,491 "to make a small profit and win the award." This is a questionable strategy because they would have improved their chances of winning the award and still made a "small profit" if their bid remained equal to their true cost.

In Phase 2, Group 7's bid price, which reflected a profit rate of eight-percent, won the SPSB award. It is interesting to note that this group was *also* the most cost efficient group in the competition and would have won the competition and earned the same profit if their bid price was set equal to their true cost. Therefore, bidding higher than their true cost to earn higher profits unnecessarily increased their risk of losing the competition.

In both phases of Experiment 2, bidding above one's cost under the SPSB method decreased the chance of winning a competition. Furthermore, *bidding higher did not improve or increase a groups opportunity for earning additional profit*. In Phase 1 the most cost efficient group that bid higher than their true cost *lost* the competition (thereby earning nothing) and, similarly, in Phase 2 the winning group who set their bid price higher than their true cost did not improve their chances of earning additional profits. One can conclude, therefore, that bidding higher than one's true cost is *irrational* under the SPSB method.

#### **4. Experiment 3 - A Shift from the FPSB Method to SPSB Method**

As provided in Appendix C, Phases I and II of Experiment 3 requested each of the five participating groups to provide a FPSB and SPSB price in response to a Government solicitation for ten infrared sensors (Phase I) and ten microprocessors (Phase II). The results are shown below in Table 10.

<b>Experiment 3, Phase I</b>					
Industry Average Cost = \$1,000					
Industry Average Profit = 8%					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	906	915	0.99%	914	0.88%
2	1,030	1,112	7.96%	1,102	6.99%
3	910	983	8.02%	<b>910</b>	<b>0.00%</b>
4	1,056	1,119	5.97%	1,056	0.00%
5	1,015	1,035	1.97%	1,056	4.04%
SPSB Winning Bidder - Group 3, Profit = 4					
<b>Experiment 3, Phase II</b>					
Industry Average Cost = none provided					
Industry Average Profit = 12%					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	9,425	9,528	1.09%	9,519	1.00%
2	9,413	10,542	11.99%	10,448	11.00%
3	11,958	13,753	15.01%	11,958	0.00%
4	8,021	8,823	10.00%	<b>8,021</b>	<b>0.00%</b>
5	11,484	11,829	3.00%	12,173	6.00%
SPSB Winning Bidding - Group 4, Profit = 1,498					

Table 10. Results from Experiment 3, Phases I & II.

*a. Experiment 3, Phase I*

In Phase I the most cost efficient group, Group 1, set their SPSB price *above* their true cost which resulted in losing the award. (One may recall that this situation was duplicated in Phase 1 of Experiment 2.) If Group 1 were to bid according to the optimal pricing theory under the SPSB method, they would have bid their true cost of \$906 and won the award. Group 3, on the other hand, bid their true cost of \$910 and won the award. Although Group 1's bid price was *only slightly* above their true cost, it proved unprofitable. Once again, this shows that setting one's bid price *slightly above* one's true cost is irrational.

Although Group 4 lost the award, they chose to set their bid price equal to their true cost. In doing so, they succinctly described the optimal pricing strategy as follows:

[Our] rationale is that our bid would just cover our cost. If we are the low bid, we will be awarded the contract and will be paid the next higher bid amount. That next higher bid will determine our profit.

***b. Experiment 3, Phase II***

In this phase Group 4 continued to practice bidding according to the optimal SPSB pricing strategy which resulted in them being awarded the contract. Additionally, the *most cost efficient group* won the award.

In Experiment 3, *only five groups* participated in each phase of this experiment. Accordingly, with limited competition, the final award price reflected a great deal more variability between the award price (\$9,519) and the true cost of the winning group (\$8,021). For example, in Phase II of Experiment 3 (Table 10), Group 4 was awarded the contract and paid an award price which represents an 18.67-percent profit rate. Such a profit rate is *dramatically higher* than all previous experiments where there was almost twice the number of competitors. In fact, in every case where there were nine or more competitors, the profit paid to the winning contractor *never* exceeded the industry-wide profit rate. Accordingly, the following is submitted:

**Under the SPSB method, as the number of competitors increase, there is a tendency for less variability between the award price and the true cost of the winning contractor.**

To further establish this observation, however, further experimentation and analysis involving varying numbers of competitors would be required.

**5. Experiment 4 - A Shift from the FPSB Method to SPSB Method**

As provided in Appendix C, Phases I and II of Experiment 4 requested each of the nine participating groups to provide a FPSB and SPSB price in response to a Government solicitation for ten infrared sensors (Phase I) and ten microprocessors (Phase II). The results are shown below in Table 11.

<b>Experiment 4, Phase I</b>					
Industry Average Cost = \$10,000					
Industry Average Profit = 8%					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	10,200	10,685	4.75%	10,200	0.00%
2	9,687	10,462	8.00%	9,687	0.00%
3	10,476	11,300	7.87%	10,600	1.18%
4	10,643	10,699	0.53%	10,536	-1.01%
5	9,306	9,957	7.00%	9,400	1.01%
6	10,817	11,399	5.38%	11,099	2.61%
7	10,597	10,703	1.00%	10,597	0.00%
8	10,030	10,500	4.69%	9,800	-2.29%
9	9,244	10,500	13.59%	10,300	11.42%
SPSB Winning Bidder - Group 5, Profit = 381					
<b>Experiment 4, Phase II</b>					
Industry Average Cost = none provided					
Industry Average Profit = 12%					
Group	Cost	1st Price	% Change	2nd Price	% Change
1	4,927	5,337	8.33%	4,977	1.01%
2	3,708	4,005	8.00%	3,708	0.00%
3	4,943	5,900	19.36%	5,500	11.27%
4	5,832	6,269	7.49%	5,831	-0.02%
5	6,280	6,908	10.00%	6,594	5.00%
6	4,971	5,488	10.40%	2	-99.96%
7	3,060	3,243	5.98%	3,060	0.00%
8	6,209	6,500	4.69%	6,200	-0.14%
9	4,858	6,100	25.57%	5,800	19.39%
SPSB Winning Bidder - Group 6, Profit = -1,911					

Table 11. Results from Experiment 4, Phases I & II.

*a. Experiment 4, Phase I*

As reflected above and observed in all previous experiments, the predominant FPSB pricing strategy was to set submit a bid price between one's true cost and the true cost-

plus-the-industry-wide profit rate. Similar to those exceptions found in earlier experiments, Group 9 has a bid price reflecting a profit rate of 13.59-percent that far exceeds the industry-wide profit rate of eight-percent. As was earlier mentioned, such a pricing strategy indicates a misunderstanding of competitive pricing strategies practiced by competitors under the FPSB method.

The most interesting observation in this phase is the downward shift in bid prices when changing from the FPSB method to the SPSB method. *This pricing pattern has been consistent throughout all other experiments.* Accordingly, one can conclude that:

**When changing the method of solicitation for a product or service from FPSB to SPSB, a general reduction in bid prices should be expected.**

One known reason for the downward pricing trend is attributed to those groups shifting from a typical FPSB pricing strategy, where bid price is *above* true cost, to setting SPSB prices in accordance with the SPSB optimal pricing strategy where bid prices are *equal* to true costs. Another possible reason, which was previously mentioned in Phase I of Experiment 1, is that the SPSB method is believed to intensify competition, thereby causing each group to reflect a bid price that is more competitive than found under the FPSB method.

Phase I of Experiment 4 reflects another instance where the SPSB price is set *slightly* below the true cost. In Table 10, Group 4's rationale for this strategy was, "We went below our cost with the assumption that the next higher bidder would *probably* be above our cost." Previously, it was shown how bidding in this manner is not representative of the optimal SPSB pricing strategy. However, when observing a tie for the winning lowest bid, where tie-breaking provisions call for the splitting of the award between the lowest tying bidders *and* awarding the third highest price, then bidding *slightly below* one's true cost could be the optimal SPSB pricing strategy.

As was seen in previous experiments, the winning group in Phase I of Experiment 4 was *not* the most cost efficient group. As reflected in this phase, Group 5 won the award where Group 9 was the most cost efficient. After further consideration we can conclude that:

**Even under the SPSB method, the winning contractor may not always be the most cost efficient contractor when competing contractors are not well**

versed in the nature of SPSB. Only in those instances where *all* groups bid according to the optimal pricing strategy will the most cost efficient group *always* be awarded a contract.

*b. Experiment 4, Phase II*

In addressing this phase, three interesting pricing strategies are highlighted. First, note Group 6's bid price of only two-dollars. Although this strategy practically guarantees winning award of the contract, it represents a *tremendous risk of winning the award in an unprofitable position*. This case was previously discussed in Chapter II (Table 5) where the lowest bid price was unrealistically set at one-dollar. Under the terms of the SPSB method, Group 6 wins the contract and is paid \$3,060. Having a true cost of \$4,971, however, Group 6 will realize a loss of \$1,911 ( $\$3,060 - \$4,971 = -\$1,911$ ) which is obviously *not optimal*. In a real-world scenario, submitting an unrealistically low bid price such as this would strongly indicate that a contractor is employing a buy-in strategy. Although a buy-in strategy is not necessarily wrong, it should raise serious concerns as to whether a contractor has the means to perform the contract. In the Government's eyes, such a bid could represent a contractor that is *not* considered a *responsible* source of supply. Accordingly, under both the FPSB and SPSB methods, contractors would still have to be a *responsive* and *responsible* source of supply.<sup>10</sup>

The next pricing strategy to be addressed includes, once again, the case where bid prices are set *slightly* below one's true cost, as reflected in Groups 4 and 8's bid prices. As stated in Group 4's rationale, "We wanted to ensure we'd at least cover our cost..., so we bid one-dollar below our cost, assuming the next higher bidder would be above [our cost]." Unlike the situation in Phase I where the industry-wide average cost was known, there was *no* industry-wide average cost provided in this phase. Consequently, there was no way to compare how one's cost were relative to the industry. The strategy presented here has its merit in that tie-breaking provisions were not known.

The third, and final pricing strategy to be addressed includes setting a bid price far above one's true cost-plus-the-industry-wide profit rate. Specifically, Group 9 reflects a bid price with an applied 19.39-percent profit rate which is 6.39-percent above the industry-wide

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<sup>10</sup> Responsive and responsible is defined in Chapter I - Definitions, under the terminology of "Contractor (bidder)."



profit rate. Accordingly, Group 9 indicated that they should earn this high rate because the contract involved "developmental technology." Once again, we witness a total disregard for one's competition.

## 6. Conclusions - A Shift from the FPSB Method to SPSB Method

The experimentation presented so far reflects a variety of SPSB pricing strategies which has resulted in unpredictable outcomes. From the experiments we have analyzed, we have seen the following SPSB pricing strategies:

- **Strategy 1:** Setting one's bid price equal to true cost (i.e., the optimal pricing strategy under the SPSB method) with the rationale that *some* profits would always be made if awarded a contract (32.4-percent of the SPSB prices submitted reflected this strategy). Thus far, there have been 22 occurrences of this strategy which has resulted in winning three of the eight SPSB solicitations. In accordance with the SPSB theory, winners who exercised this strategy *always* earned a profit.
- **Strategy 2:** Setting one's bid price *slightly* below true cost with the rationale that the next lowest bidder would probably be higher than one's true cost (10.1-percent of the SPSB prices submitted reflected this strategy). There were no instances where bidding in this manner resulted in winning an award. However, it was previously noted that this strategy may represent the optimal SPSB pricing strategy under very specific circumstances.
- **Strategy 3:** Setting one's bid price higher than true cost, yet lower than true cost-plus-the-industry-wide profit rate with the rationale of undercutting the competition's bid price (51.5-percent of the SPSB prices submitted reflected this strategy). Accordingly, this was one of the more popular strategies used under the SPSB method. Of the experiments conducted, 50-percent of those winning the competition exercised this strategy.
- **Strategy 4:** Setting one's bid price *above* the true cost-plus-the-industry-wide profit rate (3.0-percent of the SPSB prices submitted reflected this strategy). Not surprisingly, this strategy was never successful. When competition exists and the

SPSB method is applied, one should never expect to witness the case where bidding in such a manner becomes profitable.

- **Strategy 5:** Setting one's bid excessively low (e.g., equal to \$1) to assure winning award with the rationale of bidding under a buy-in strategy (3.0-percent of the SPSB prices submitted reflected this strategy). Although such a strategy practically guarantees award, the long-term survivability of any contractor is questionable. Accordingly, bidding in such a manner did result in winning the award, however, the winning group did sustain a significant loss.

One of the more interesting observations that occurred throughout *all* the four experiments was the downward pricing trend in bid prices when changing from the FPSB method to the SPSB method. As mentioned earlier, this was partially attributed to:

- groups shifting from a typical FPSB pricing strategy, where the bid price is set above true cost, to setting SPSB prices in accordance with the SPSB optimal pricing strategy, where bid prices equal true costs.
- the SPSB method being *perceived* as intensifying competition, thereby causing each group to reflect bid prices that are more competitive than found under the FPSB method.

As was expected, the level of competition has an effect on the percentage of profit awarded in the SPSB method. As mentioned earlier:

**Under the SPSB method, as the number of competitors increase, there is less variability between the award price and the true cost of the winning contractor.**

In the above experiments several different pricing strategies were applied by groups who submitted bid prices subject to the terms of the FPSB method and the SPSB method. In conducting these experiments, however, these groups were never informed as to what other groups' bidding prices were and who was the winning bidder. Armed with such information, these groups could make more informed decisions in formulating future pricing strategies. Experimentation in this regard may provide trends in bidding behavior that could be beneficial to understanding second-pricing strategies. In the second set of experimentation, interesting trends *do* emerge that shed light in the application of the SPSB method.

## B. EXPERIMENTATION WITH THE SECOND-PRICE AUCTION

This section views the second-pricing mechanism as used within the context of *auctioning*. The mechanisms in second-price auctions is theoretically *identical* with the SPSB method. In second-price auctions, "sealed bids are entered simultaneously, and the highest bidder wins the item and pays the second highest bid." Accordingly,

What makes this type of auction so appealing is that the optimal bid is a dominant strategy; that is, it is independent of the actions of the other bidders. If an individual bids above his value, then he must face some probability of winning the item and paying more than his value, while if he bids below his value he must face some probability of someone else winning at a price below his value. The way to avoid these possibilities is for the individual to bid the value of the item. [Ref. 10, p. 136]

The mechanisms found in both the SPSB method and second-price auctions is identical when one consider that the winning bidder (contractor) pays the second highest (lowest) bid price offered. Theoretically, the optimal pricing strategy is to bid at one's true value (true cost) of an item (contract).

With this understanding of how the two are essentially the same, the thesis analyzes second-pricing auction experimentation conducted by the economist Dr. William Gates at Naval Postgraduate School and applies the findings to the SPSB method.

### 1. The Setting for Experimentation

To accomplish the experimentation of second-price auctions, Dr. Gates conducted five independent classroom experiments, with each experiment consisting of four sequential rounds of bidding. In each experiment, ten groups of graduate students from the Naval Postgraduate School were formed, where each group consisted of a three-member team. Working independently, each team was given their unique "value" of an item to be offered at auction. Under the terms of a second-price auction, each team would then submit their sealed bids. Once submitted, a consolidated listing of all groups' valuations and bid prices were projected on an overhead, thereby allowing each group to view all other groups' valuations and bidding prices. The intentions for the "public" showing of this information was for each group to reassess and revise, if necessary, their strategies in the remaining three rounds of bidding. Table 12 provides an example of a typical overhead presented during the first round.

<i>Experiment 1, Round 1</i>		
<b>Second Price Auction</b>		
<b>Group</b>	<b>Value</b>	<b>Bid</b>
1	9354	9354
2	<u>9789</u>	<b>10000</b>
3	9998	<u>9950</u>
4	8915	6500
5	9254	9255
6	8562	6850
7	9687	9600
8	9543	9543
9	8264	8264
10	8176	8000
Group	2	
Profit	-161	

Table 12. Experiment 1, Round 1.

In this round the winning bid was submitted by Group 2 having the highest bid price of \$10,000. In accordance with the terms of the second-price auction, this group received the item and paid the next highest bid of \$9,950 which was submitted by Group 3. Therefore, the first round of auctioning resulted in Group 2 winning the award with a -\$161 profit (the winning bidder's value minus the next highest bid price;  $\$9,789 - \$9,950 = -\$161$ ). Immediately following the first round, all groups were provided a *new* set of unique values and were again requested to submit a bid. This process would be repeated until four successive rounds were completed. Additionally, where a tie exists for the highest bid, the winner was determined by a flip-of-the-coin.

Accordingly, this experiment was conducted to determine if any pricing trends and/or predominant pricing strategies would emerge. This will be discussed in the next section.

## 2. Examination of Experiments

In conducting an examination of all five experiments (which totaled twenty rounds of experimentation) the thesis will focus on the summary of data found in Appendix E. In this analysis, four overall trends emerge that are supported by this data. Each trend will now be discussed in detail.

### *a. Trend 1 - A percentage decrease of variation as rounds progressed*

The average percent of variation between groups' bid prices and their true valuations consistently *decreased* as each of the five experiments progressed from Round 1 to Round 4. The data supporting this statement are provided below in Table 13.

Summary of Variances				
	Round 1	Round 2	Round 3	Round 4
Experiment 1	4.62	0.94	0.74	0.14
Experiment 2	56.01	126.44	0.98	1.67
Experiment 3	1.77	8.05	4.45	1.60
Experiment 4	11622.07	5.73	6.81	6.25
Experiment 5	11617.12	1.36	0.34	0.38
Total Variance	23301.59	142.52	13.32	10.04
Average Variance	4660.32	28.50	2.66	2.01

Table 13. Summary of Variances.

In determining the percent of variation for each round, as reflected in Table 13 above, refer to Table 14 which is an excerpt from Appendix E.

<i>Experiment 1, Second Price Auction</i>			
<b>Round 1</b>			
<b>Group</b>	<b>Value</b>	<b>Bid</b>	
<b>1</b>	9354	9354	
<b>2</b>	<u>9789</u>	<b>10000</b>	
<b>3</b>	9998	<u>9950</u>	
<b>4</b>	8915	6500	
<b>5</b>	9254	9255	
<b>6</b>	8562	6850	
<b>7</b>	9687	9600	
<b>8</b>	9543	9543	
<b>9</b>	8264	8264	
<b>10</b>	8176	8000	
<b>Total</b>	<b>91542</b>	<b>-87316</b>	<b>= 4226</b>
<b>Group</b>	<b>2</b>	<b>% Var =</b>	<b>4226 / 91542</b>
<b>Profit</b>	<b>-161</b>	<b>=</b>	<b>4.62</b>

Table 14. Experiment 1, Round 1, Second-Price Auction.

For each round of each experiment, the “Value” and “Bid” columns were totaled as shown above, where totaled values equal 91542 and 87316, respectively. In subtracting one total from the other, a net difference was determined ( $91542 - 87316 = 4226$ ). This difference was then divided by the sum of the “Value” column which produced an average percentage variation between all ten groups for Round 1 of Experiment 1 ( $4226/91542 = .0462$  or 4.62-percent). Accordingly, Round 1 of Experiment 1 has a percent of variation of 4.62-percent. Hence, one can conclude that Round 1 has an average of 4.62-percent variation between groups’ true “Value” and their “Bid” prices.

Referring back to Table 13, following each successive round of bidding each group reassessed their bidding strategy and submitted, in general, a bid price closer to their true valuation. In applying this trend to the SPSB method, one would conclude that **bid prices from contractors engaged in numerous successive SPSB solicitations would be expected to converge closer and closer to their true cost.** Accordingly, as contractors continue

participating in SPSB solicitations, the greater the likelihood that their bid prices will be closer to their true cost.

*b. Trend 2 - Dominant bidding strategies*

In continuing our examination of the bidding strategies presented in the exercises found in Appendix E, note that the final round of *all* five experiments had only *two in fifty cases* where bidders bid *below* their true valuation. In fact, 46-percent of those bidding in the final round bid their true valuation while the remaining 50-percent bid *above* their true value. Of the 50-percent that bided above their true valuation, 52-percent bid *slightly above* their true valuation<sup>11</sup>. This reflects an interesting behavioral pattern in that a majority of bidders will bid according to the optimal second-price strategy, or to take chances in bidding higher than their true valuation. Bidding higher than one's true value, you may recall, improves the chance of winning the auction, but concurrently increases the chance of winning in an unprofitable position.

In applying this trend to the SPSB method, one would expect that **contractors engaged in numerous successive SPSB solicitations will adopt a pricing strategy of setting bid prices equal to, or below their true cost. In those cases where contractors' prices are set below their true costs, half of these bids would be expected to be priced *slightly* below their true cost.** It is interesting to contrast this finding with the first set of experiments where the majority of groups set their prices *above* their true costs. One may recall, however, that these groups set their bid prices *without* any knowledge of the successes (or failures) of their previous pricing strategies. In the current set of auctioning experiments, the vast majority (88.9-percent) of the pricing strategies consisted of bidding equal to, or higher than one's true cost. As indicated in the current set of experiments, one would expect the groups in the first set of experiments to eventually revise their pricing strategies in future SPSB solicitations towards submitting bid prices equal to, or *lower* than their true cost.

*c. Trend 3 - Consistency in bidding equal or slightly greater to one's true cost*

Those groups bidding equal to, or slightly greater than their true costs in the first three rounds of each experiment tended to remain with these strategies through to the final round

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<sup>11</sup> A bid price *slightly above* one's true value is defined here as a bid price being within one percent above one's true valuation.

(i.e., Round 4). Stated another way, once a group set their bid equal to, or *slightly* greater than their true value, they tended to stay with that pricing strategy for the remaining rounds of the experiment.

Consequently, one might expect that **contractors adopting the optimal SPSB pricing strategy of bidding their true cost are likely to remain with this strategy.**

*d. Trend 4 - Bidding equal to one's cost does not ensure winning the award*

In focusing on the final round of each of the five experiments, note that bidding a price equal to ones true value does not consistently result in winning auctions as shown below in Table 15.

<b>Experiments 1-5, Round 4</b>			
	<b>Winning Group</b>	<b>Percent of Bid Price Above True Value</b>	<b>Percent of Profit Earned</b>
<b>Experiment 1</b>	8	0.11%	0.22%
<b>Experiment 2</b>	1	11.98%	-2.69%
<b>Experiment 3</b>	10	11.73%	-1.68%
<b>Experiment 4</b>	3	10.00%	0.10%
<b>Experiment 5</b>	2	0.00%	5.26%

Table 15. Winning groups of Round 4.

As seen above, in the final round of each of the five experiments there exists different strategies that resulted in winning second-price auctions. For example,

- **Experiment 1:** The pricing strategy used by Group 8 was to bid *slightly above* their true value which resulted in earning .22-percent profit. In the SPSB method, this would be equivalent to a contractor bidding *slightly below* their true cost and winning the contract and earning a rate of .22-percent profit.
- **Experiments 2 through 4:** The pricing strategy used by Groups 1, 10, and 3 reflect the strategy of bidding *above* (vice *slightly above*) one's true value. In this manner of bidding Groups 1 and 10 won the award but earned a *negative* profit. As for Group 3, they bid in the same manner, but, in contrast to groups 1 and 10, earned a very small 0.10-percent profit. Consequently, it appears that bidding *higher* than one's true cost is



not especially profitable. In applying these observations to the SPSB method, one might conclude that contractors pursuing a pricing strategy of setting bids below their true cost is not profitable. Obviously, the long-term implications of consistently using such a strategy would ultimately result in bankruptcy.

- **Experiment 5:** This experiment reflects the only case where bidding equal to one's true cost resulted in winning an auction. In this case it is noted that the profit earned under this pricing strategy far exceeded those profits earned under the pricing strategies seen in Round 4 of Experiments 1 through 4. In applying this to the SPSB method, therefore, would indicate that setting a bid price equal to one's true cost generates the highest profit when compared to other pricing strategies.

Although the results above compel the reader to accept that the best SPSB strategy for a contractor is to bid their true cost, this thesis hesitates to make this, or any other strong conclusions due to the limited number of experiments conducted. Accordingly, further experimentation and analysis would be warranted that may reinforce or change the findings reflected above.

### **C. THE SPSB METHOD - GENERAL OBSERVATIONS**

To summarize the observations from experimentation found in this chapter, the following conclusions regarding the SPSB method are reiterated:

- Contractors bidding higher than their true cost act irrationally because they increase the risk of losing an award, thereby diminishing the chance of earning any sum of profit.
- Bidding higher than true value does not improve or increase one's opportunity for earning additional profit
- As the number of competitors increase, there is a tendency for less variability between the award price and the true cost of the winning contractor.
- When changing the method of solicitation for a product or service from FPSB to SPSB, a general reduction in bid prices should be expected.
- The winning contractor may not always be the most cost efficient contractor when competing contractors are not well versed in the nature of SPSB. Only in those

instances where *all* contractors bid according to the optimal pricing strategy will the most cost efficient contractor *always* be awarded a contract.

- Bid prices from contractors engaged in numerous successive SPSB solicitations would be expected to converge closer and closer to their true cost.
- Contractors engaged in numerous successive SPSB solicitations will adopt a pricing strategy of setting bid prices equal to their true cost. In those cases where contractors' prices are set below their true costs, half of these bids would be expected to be priced slightly below their true cost.
- Contractors adopting the optimal SPSB pricing strategy of bidding their true cost are likely to remain with this strategy.

#### **D. SUMMARY**

In this chapter the thesis has examined two sets of experiments which have revealed numerous interesting observations. In the first set of experiments a consistent reduction in bid prices was observed when shifting from the FPSB method to the SPSB method. Additionally, the theoretical mechanisms which formed the basis of the SPSB method presented in Chapter II were shown. In the second set of experiments, trends in second-price auctioning were observed which imply that contractors who are engaged in successive contract SPSB solicitations will, in general, bid equal to, or below their true cost. In the next chapter, survey results received from Government and private industry respondents concerning the applicability of the SPSB method in Government contracting is addressed.

#### **IV. SURVEY RESULTS REGARDING THE SPSB METHOD**

To assess the opinions of Government and private industry contracting professionals regarding the use and applicability of the SPSB method in Government contracting, this chapter presents a series of survey questions asked with analysis and discussion on the responses offered. The chapter is segregated into two categories; Category 1 consisting of responses from private industry contracting professionals, and Category 2 consisting of responses from Government contracting professionals. In separating the two categories in this manner, a comparison between the buyer, the Government, and the seller, private industry, is provided. A full listing of Government and private industry contracting professionals surveyed is found in Appendix A. A total of ninety responses were received from Government contracting professionals and thirty-two responses were received from private industry contracting professionals. A complete listing of survey questions is provided in Appendix B. As reflected in Appendix B, Section I of the survey determines the background and experience of the respondents and Section II contains the those questions requesting the perceptions and opinions from respondents regarding the SPSB method.

##### **A. THE SPSB METHOD SURVEY - PRIVATE INDUSTRY**

###### **1. Respondents Background and Experience - Private Industry**

A total of thirty-two survey responses were received from private industry contracting professionals. Their background and experience were as follows.

- Sixteen of the thirty-two respondents consisted of senior/executive management. Of these sixteen respondents, fifteen had over ten-years, and one had five to ten years experience in the procurement/contracting field. Furthermore, of the Sixteen respondents, fourteen had over ten years, one had five to ten years, and one had three to five years experience *specifically* in Fixed-Firm Price (FFP) type contracting.
- Sixteen additional respondents were identified as being contracting specialists (e.g., those individuals who drafted, solicited, awarded contracts, or were involved in the preparation of bid proposals). Of these sixteen respondents, fourteen had over ten-years, and two had between five to ten years experience in the procurement/contracting

field. Furthermore, of these sixteen respondents, thirteen had over ten years, and three had three to five years experience *specifically* in Fixed-Firm Price (FFP) type contracting.

- All but one of the respondents were employed by a large company (e.g., employed by large contractors such as Lockheed, Martin Marietta, Boeing, Motorola, TRW, etc.).

In view of the above, the respondents from private industry were highly experienced individuals which had, in general, over ten years in the procurement/contracting field and over ten years of direct involvement with FFP type contracts. Accordingly, their responses should be considered highly credible. Unfortunately, the vast majority of respondents represented large companies instead of small business. Therefore, the survey responses received from private industry do not adequately represent small business concerns.<sup>12</sup>

## **2. SPSB Survey Questions - Private Industry Respondents**

### ***a. Question 1: Have you ever been exposed to the Second Price Solicitation (SPSB) Method?***

All thirty-two respondents answered that they had never been exposed to the Second Price Solicitation (SPSB) Method. This response was anticipated in that the SPSB method had never been previously used in Government procurement and contracting. Accordingly, it is assumed that this survey was the *first* (initial) opportunity that private industry contracting professional had in expressing their perceptions and opinions regarding the SPSB method.

### ***b. Question 2: If allowed by law, would you as a buyer consider soliciting a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation (SPSB) Method?***

In response to this question, five of thirty-two respondents answered "Yes, with reservations." Accordingly, this response indicates that the SPSB method might be considered by a *minority* of the private industry contracting professionals .

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<sup>12</sup> Of note, several responses were received from Government small business regional offices which did provide some opportunity for small business representation.

Six of the thirty-two respondents answered "Neutral/uncertain" primarily because of 1) their being unfamiliar with the SPSB method and 2) a lack of "benchmark data" for determining the success of the SPSB method. Another concern expressed was,

Although the second price solicitation method does permit the focus to reside on the cost side of the pricing equation, it introduces an element of risk beyond the reasonable control of management. Essentially profit is determined solely by forces outside the control of the seller.

In considering this statement, the SPSB method is perceived as posing a "risk" with regard to the amount, or percentage, of profit a winning bidder can earn. It should be noted, however, that by minimizing costs, management maximizes potential profit which *is* a form of controlling profit "risk."

Fifteen of thirty-two answered that they would *not* consider using the SPSB method in soliciting a contract. Included in their responses were the following.

The assumption that a bidder will allow the difference between its bid price and the next highest price to determine the profit is questionable. More probably, the bidder will bid a reasonable price *including* profit and then accept the higher price. Consequently, the Government pays more than it would under the First Price Solicitation Method [FPSB method].

The Second Price may be pennies more than the lowest bid, So the low bidder gets the award with pennies profit. *Where is the incentive?*

No businessman would continuously bid cost...The expectations for profit [are] not predictable so businessmen would not participate.

...This method is grossly unfair to contractors and will ultimately be bad for the Government. In a changing environment (fewer contracts, changes in supplier sources, smaller production runs, etc.) contractors can not determine with complete accuracy in advance what their "actual costs" are. There are risks in all fixed price contracts, and these risks are often compensated for by proposing profit. Under the proposed scenario, the amount of risk the contractor assumes is determined by his competitors pricing strategy...The risks of FFP contracting require a reasonable profit.    \

Accordingly, these respondents believed that the SPSB method does not guarantee a reasonable, or incentivizing, profit which is considered *the* fundamental element of

FFP type contracting. Apparently, *there is a gross misunderstanding of the SPSB method by both Government and private industry respondents*. In several instances, their survey responses addressed the lack of contractors' ability to control their profit margin, or return on investment, when setting bid prices. When developing a bid price, contractors *should* accumulate all relevant costs, to include, for example, a minimal rate of return (or profit) that reflects corporate policy. Furthermore, setting a bid price greater or less than this amount would represent an opportunity trade-off. As such, setting a bid price *below all relevant costs* would represent a trade-off between earning less profit to increase the chances of winning an award. Additionally, this strategy may reflect a buy-in strategy on behalf of the contractor. Conversely, setting a bid price *above all relevant cost* would represent a trade-off between increasing profit while increasing the chances of losing the award to a lower bidder.

There were three comments that expressed concerns that the SPSB method would introduce negotiations in the form of "letting a contract for an amount different [than] that proposed [which] constitutes an counter offer." Accordingly, in Government contracting, a counter offer is considered a form of negotiating, which is not allowed in Government sealed bidding. [Ref. 3, p. 242] As presented in this thesis, however, the SPSB method, like the FPSB method, was intended to *exclude any form of negotiations*.

Fundamentally, an offer gives the offeree the power to accept or reject. The counteroffer switches this power from the original offerree to the original offeror. Is there even an argument that the award of an SPSB contract gives the original offeror the power to accept or reject the award?...It should be clear to all parties from the description of the method that no such powers are granted or intended. The offeror would be saying in his offer that this is my price and I am giving the buyer the power to accept my offer but at the definite price of the next highest offeror. There is a price certain and a firm offer. There is no exchange of powers. [Ref. 12]

Therefore, implementing the SPSB method would require statutory language to the effect that the *final bid price awarded is not considered a "counter offer" subject to negotiation*.

The remaining seven of thirty-two respondents elected not to answer this question.

*c. Question 3: If allowed by law, would you as a seller consider submitting a bid for a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation (SPSB) Method?*

In answering this question, two respondents replied "Yes, definitely" while eight respondents replied "Yes, with reservations." Their comments included,

[I] would prefer that the Government continue to use the Sealed Bid method [the FPSB method]. However, if the Government *insisted* on the latter [the SPSB method], [I] would participate on that basis.

In general, if the Government were to issue a solicitation having the SPSB method, roughly one-third of the private industry respondents surveyed would respond with a bid. Accordingly, this would indicate that using the SPSB method could potentially *reduce* the number of competitors by two-thirds.

Thirteen respondents provided the response "Neutral/uncertain" as to whether they would submit a bid under the terms of the SPSB method. Some stated that they might participate, however, indicated that their pricing strategy would *not* change from previous practices (i.e., their bid price would reflect their sealed bid (FPSB) strategy). Several respondents expressed concern over the expected profit to be earned if awarded the contract. Accordingly, when a profit entailing an "acceptable" return on investment could be obtained, they would participate in an SPSB solicitation. Others were uncertain as to whether they would participate in an SPSB solicitation because of their perceived "add[ed] element of risk" that could not be controlled. As well, others would hesitate to participate because of their unfamiliarity with second-pricing.

The remaining nine respondents would *not* submit a bid in response to a SPSB solicitation. As discussed before, their concerns consisted of "not having any assurances of earnings that would result in an acceptable ROI/ROE." Other statements included,

For the Second Price Solicitation Method to be a viable option an assumption must be made that each of the competitors have comparable accounting systems to the extent that "actual" [true] costs are recognized in a like manner...Also, if true competition exists, the variance between the first and second price may be so small as to result in a loss to the awardee.

This approach is contrary to the basic free enterprise system. A contractor should win or lose on his own bid - and be paid based on his own bid...The Government would be creating an artificial situation that is a "roll of the dice" for would-be winners of competition. As a tax payer, I want my Government to pay the correct price - not someone else's.

A related statement which merits mentioning was, "Why should a businessman risk his profit return on the expertise (or lack thereof) of other bidders?" In fact, experimentation in Chapter III revealed numerous instances where flawed bidding strategies resulted in winning awards. Such occurrences would tend to label the SPSB method as another extension to game playing, where contractors are continually trying to second-guess one another.

One interesting response was as follows,

This [second price] sealed bid [method] would reveal to all what my estimated costs for the item or services [is]. That is customarily treated as proprietary and competitive sensitive [information]. This [cost revealing] mechanism will make it public information [which would then be] available to the competition.

In considering this statement, one would question whether the SPSB method would tend to limit competition because of contractors' unwillingness to reveal their costs (i.e., their bid price) to their competitors. In setting one's bid price equal to their cost, it is interesting and worth considering whether a contractor's bid should be regarded as *proprietary* information. In conducting negotiations for cost type contracts, "individual contractor costs are usually considered proprietary information." As was mentioned earlier, however, a contractor's bid price includes *all relevant costs*, including an acceptable profit margin. In that bid prices do not reflect individual cost elements, treating a bid price as proprietary information, as discussed above, is unfounded.

Overall, private industry's willingness to participate by bidding in response to a Government SPSB solicitation was mixed. On one hand, some contractors would bid if they were assured adequate profits, while others would not because SPSB runs contrary to free market forces.



***d. Question 4: Do you believe that the Second Price Solicitation (SPSB)***

***Method lessens administrative requirements for contractors?***

Of the thirty-two responses, only four believed the SPSB method lessens administrative requirements for contractors. The remaining twenty-eight of respondents believed that the SPSB method would have no effect. For a majority of these responses, respondents indicated that there would be no change because contractors would still, "evaluate actual costs and extrapolate to support estimates for future work." Additionally, "...the same costing effort would be required and management would still have to set a pricing strategy" where the "bulk of effort is involved in determining cost." In fact, determining a pricing strategy was considered necessary in light of the "expertise (or lack thereof) of other bidders" and the "risks...to be factored into the price." Accordingly, these respondents believe that formulating price/counter-price strategies would still be necessary in the SPSB method, despite the SPSB theory of simply setting one's bid price equal to their true cost.

...for procurements under \$100,000...profit determination is relatively simple. Most administrative effort involves cost estimating. Profit is a relatively small amount in the total price. Thus, the internal review procedures will not change. In fact, the decision to bid at zero profit may cause more extensive reviews. Many companies are not permitted to submit bids with a zero profit *without* higher management approval.

Accordingly, the introduction of the SPSB method may actually result in *increasing* the administrative effort on behalf of the private industry.

***e. Question 5: Do you believe that the Second Price Solicitation (SPSB)***

***Method lessens administrative requirements for the Government?***

In response to this question, two of the thirty-two respondents answered "Yes, extensively," with six responding "Yes, to a small extent," and twenty-four responding "No." Although there were a handful of respondents that thought the SPSB method would lessen administrative requirements, they did express *some* pessimism such as, "Once again a method that avoids the thinking process [on behalf of the Government]!" and "[It is] unlikely that [the] Second Price Solicitation Method would make market surveys [for price reasonableness]...unnecessary."

Comments from those in private industry that believe the SPSB method does *not* lessen the administrative requirements for the Government state that the pre-award administrative efforts such as “developing specifications, securing budgets, evaluating proposals for technical compliance, etc.,” and “determining responsible/responsiveness” do not change. As further stated, the award process becomes “more involved” under the SPSB method in that the Government would have to draft an “explanation letter” for the low bidder explaining how the final contract price, which was not the winning bidder’s price, was determined. One final comment implied that the SPSB method would “generate claims and protests that would *far* exceed current practices.” (Unfortunately, these respondents failed to provide any reasoning as to *why* there would be an increase in protests and claims.) Therefore, the Government would expend *additional* resources in litigation.

Overall, the majority of those in private industry were highly skeptical that they, or Government contracting agencies/commands would see any reductions in their administrative requirements under the SPSB method. Additionally, some even believed that administrative requirements would actually *increase*.

***f. Question 6: Do you believe that the Second Price Solicitation (SPSB) Method would increase or decrease competition?***

The majority of private industry respondents indicated that there would be no change, or a decrease, in competition with the introduction of the SPSB method. Specifically, fifteen responded “No increase/decrease,” ten responded “Probable decrease,” and five responded “Definite decrease.” Only one respondent believed that competition would “Probable increase” while another stated there would be a “definite increase in the short-run” *and* a “definite decrease in the long-run.” Accordingly, one respondent offered the following.

Given the over capacity in the defense industry, competition between contractors is already intense. Contractors would, in practice, not adhere to...the theoretical assumption of bidding actual [true] cost, particularly when survival of an individual company depends upon the business won. Competition in the short-run would likely increase as companies would bid lower than otherwise to win the business, in hope that the second higher price amount would cushion their losses...

It was further implied that competition in the long-run would decrease as contractors leave the defense industry for more lucrative business in the private sector.

In a closer examination of these responses from private industry, those who thought that competition would not change, or decrease, *also* indicated that they were either uncertain, or against, participating in SPSB solicitations.

*g. Question 7: Would you be interested in obtaining additional information concerning the Second Price Solicitation (SPSB) Method?*

In asking this question, it was believed that those answering in the affirmative might *consider* participating in future SPSB solicitations. Additionally, this question was presented to gauge the level of interest from private industry in the SPSB method. Having stated this, twenty-two of thirty-two respondents (68.75-percent) were *not* interested in receiving additional information on the SPSB method, while ten of thirty-two respondents (31.25-percent) were. Accordingly, the conclusion is that a majority of private industry contracting professionals are not willing to consider future applications of the SPSB method.

*h. Additional comments:*

The following highlights additional comments from private industry contracting professionals that have not been previously cited, but are pertinent to the SPSB method.

Profit is the cornerstone of the competitive environment. To remove this element would greatly increase the risk to the contractor. In those instances where competition is great, the potential for loss by an awardee increases [assuming that the contractor is compelled to bid below his cost]. In those instances where competition is slight, the potential for the Government to pay greater than fair and reasonable price would increase.

In recalling experimentation in Chapter III (specifically, Experiment 3, Phase II), the above statement is supported to the extent that when competitors are few, there exists a higher likelihood that the winning contractor would receive a significantly higher profit rate.

The [SPSB] idea is totally illogical to me. I...disagree that this would accomplish the [stated] objectives [of the SPSB method which] are already being accomplished by with the sealed bidding [FPSB], or at least accomplished as well as they would...under the [the] Second Price Solicitation Method. The process of sealed bidding is working today. I suggest we leave this process alone.

I have significant reservations about this approach to bidding! First I think it will result in more "game playing" and "gambling" than already exists in the fixed price sealed bid contracting world. Second, it appears to be a ploy for reducing contractor profit margins; it might work for a while, but I would be concerned that in the long run it might reduce competition and/or encourage collusive bidding in areas where there is a very limited number of suppliers.

Putting into place practices which vector contractors to submit bids without profit is contrary to stated Government policy and detrimental to the Government/ Contractor relationship. Contractors need and deserve reasonable profit on the work they do for the Government.

Accordingly, private industry is highly skeptical in the application of the SPSB method because of a perceived 1) loss in "profit margins" and 2) unnecessary increase in "game playing."

## **B. THE SPSB METHOD SURVEY - GOVERNMENT**

### **1. Respondents Background and Experience - Government**

A total of ninety survey responses were received from Government contracting professionals. Their experience and background were as follows.

- Fourteen of the Government respondents consisted of those who formulated, issued or audited Government contracting policy. Of these fourteen, thirteen had over ten-years, and one had between five to ten years experience in the procurement/contracting field. Furthermore, of the fourteen respondents, twelve respondents had over ten years, and two had five to ten years experience *specifically* in Fixed-Firm Price (FFP) type contracting.
- Seventy-six additional respondents were identified as Government contracting specialists who either drafted, solicited, awarded contracts or performed post-contract administration. Of the seventy-six respondents, fifty-eight had over ten years, twelve had between five to ten years, and six had three to five years experience in the procurement/contracting field. Furthermore, of the seventy-six respondents, fifty-five

had over ten years, eleven had five to ten years, and eight had three to five years experience *specifically* in FFP type contracting.

Similar to the respondents in private industry, the majority of Government contracting professionals were highly experienced individuals with over ten years in the procurement/contracting field and over ten years direct involvement with FFP type contracts. Accordingly, the responses received from Government contracting professionals should be considered highly credible.

## **2. SPSB Survey Questions - Government Respondents**

### ***a. Question 1: Have you ever been exposed to the Second Price Solicitation (SPSB) Method?***

All but one of the ninety respondents answered that they had never been exposed to the Second Price Solicitation (SPSB) Method. Similar to the responses received from private industry contracting professionals, this response was anticipated in that the SPSB method had never been previously used in Government procurement and contracting. Accordingly, it is assumed that this survey was the *first* (initial) opportunity that Government respondents had in expressing their perceptions and opinions regarding the SPSB method. The one positive response had only heard of second-pricing but could not elaborate further.

### ***b. Question 2: If allowed by law, would you as a buyer consider soliciting a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation (SPSB) Method?***

Of the ninety Government respondents, thirty-one answered "Yes, with reservations." Before adopting the SPSB method, however, "more information would be needed before endeavoring in this, or any other innovative scheme." Although numerous Government responses indicated a willingness in using the SPSB method, there was still reluctance that private industry would be willing to participate.

I find it hard to believe that contractors would reveal actual costs to their competitors and allow someone else to set their profit, which could be very low. Quite a gamble for the contractor.

Eighteen respondents replied "Neutral/uncertain" as to whether they would consider using the SPSB method. Numerous respondents indicated that they needed more information about the SPSB method before its implementation. Additionally, there were concerns of buy-in strategies that could possibly be detrimental to the Government-private industry relationship.

The majority of the Government respondents, forty-one of ninety, indicated that they would *not* consider using the SPSB method in soliciting FFP type contracts.

I believe the free market pressures would cause each competitor to "discount" his or her bid in order to win the award. This would then cause too much game playing and added risk. Since the contractor would, in addition to estimating his/her projected costs, would now attempt to lower their bid by an amount he/she would expect the next lowest offeror to bid. In effect, this method would add risk by introducing more unknowns to the process...

Industry will not be driven to bid a price with no profit. I would expect proposed prices comparable to [the] first price method with the end result being that the Government ends up paying a price higher than we would have received under the first price solicitation method.

Several Government respondents added that they did not believe that contractors would be awarded a reasonable profit or "fair rate of return" under the SPSB method. For example, "where many competitors exist, the cost difference between the lowest bidders would be very small," entailing that the winning bidder would only be awarded a "relatively small portion of profit in comparison to current sealed bid practices." This belief was *also* expressed by private industry respondents. As was discussed with private industry, the concept that profit is not included in the SPSB method is *incorrect*. Accordingly, setting a bid should include all relevant costs, including a *margin* of profit.

Others indicated a concern that the Government would begin receiving inferior products due to cost cutting practices by contractors which would eventually degrade the quality of their products. (One must consider if this situation does not already exist.) One respondent expressed that "The federal procurement system is already viewed by the public with distrust. I feel the second price method would only solidify their concerns of a system genuinely gone bad." Accordingly, those who perceive that an adversarial environment exist between the Government and private industry, then the introduction of the SPSB method would only worsen this situation.

Many respondents considered the SPSB method as "ill-conceived" and "too contrary to normal business practices in the U.S. and difficult for the vast majority of smaller bidders to understand or accept."

*c. Question 3: If allowed by law, would you as a seller consider submitting a bid for a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation (SPSB) Method?*

Government contracting professionals surveyed were not asked this question because they are never in the position of being a "seller." Therefore, no response was provided.

*d. Question 4: Do you believe that the Second Price Solicitation (SPSB) Method lessens administrative requirements for contractors?*

In *contrast* to private industry's overwhelming response that there would be *no* lessening of the administrative function, approximately one-third of Government respondents (twenty-seven of ninety) thought this function would decrease to a *small extent*. One respondent did comment that a small reduction would occur "only if the contractor is willing to let someone else [i.e., another competing contractor] determine profit. Not very likely."

The remaining two-thirds of Government respondents did *not* believe that contractors would see a lessening in their administrative requirements. The *vast majority* of respondents in this category thought there would no change because contractors would continue to analyze and formulate "realistic" bid prices as they have done in the past. Accordingly, they would still accumulate 1) data necessary in forecasting expected costs, 2) competitor's pricing strategies to formulate counter-pricing strategies and 3) data identifying return on investment that will provide "some type of idea of the potential profit margin" to be gained from the contract. In fact, there were a number of respondents who thought there would be an *increase* in the administrative function because "contractors will have another complication to deal with" which would "require more pricing strategies to determine how...they will bid."

Overall, Government respondents were *highly* skeptical the contractors would see any reduction in administrative requirements.

*e. Question 5: Do you believe that the Second Price Solicitation (SPSB) Method lessens administrative requirements for the Government?*

Of the ninety Government respondents, four replied "Yes, extensively" and seventeen replied "Yes, to a small extent." Accordingly, twenty-three percent of Government contracting professionals believed that their administrative requirements would be lessened, to some extent.

However, sixty-seven Government respondents replied that there would be *no* lessening of the Government administrative requirements. In fact, numerous respondents in this category believed that the administrative requirements would *increase*.

This practice may yield lower initial Government costs, but increases greatly the probability of contractor performance problems such as inferior material usage, less experienced personnel and delays due to the inability to show profitability. Government involvement would probably be greatly increased due to these problems.

Other respondents cited that Government administrative requirements would increase due to the additional step of determining the next lowest bid price. Furthermore, "additional time would be spent dealing with 'hot line' complaints trying to explain why an award was made at a price higher than on the bid."

Any situation where the PCO [Program Contracting Officer] would be paying other than proposed on a fixed price basis would probably require additional analysis and/or documentation.

A *majority* of the respondents commented that the Government would *still* need to 1) determine price/cost reasonableness to assure contractor's ability to perform, and 2) conduct the market research necessary in determining responsiveness of prospective Government contractors. Additionally, one respondent asked the question, "What about the Contracting Officer determining the low [bid] as not [being] fair and reasonable - then does the second low become the first low?" "You still have to open all the bids and would still be subject to protests." In view of this, one would expect additional protests and claims which would result in *increased* post-award administrative requirements.

Two additional respondents elected not to answer this question.



*f. Question 6: Do you believe that the Second Price Solicitation (SPSB)*

*Method would increase or decrease competition?*

Twenty-five of the ninety respondents indicated that they would expect a *decrease* in competition under the SPSB method. Specifically, four replied there would be a "Definite decrease" and twenty-one replied "Probable decrease." The majority of respondents who indicated that a reduction in competition would occur stated that contractors would be unwilling to engage in Government contracts that could result in unacceptably low profits. Accordingly, uncertainties in earning would reduce the number of competitors. As expressed by two respondents,

I believe that most responsible contractors would not bid without profit. Thus, this [SPSB] method would encourage and reward new inexperienced contractors to bid and win jobs. This could be harmful to their business as a continued lack or low profit will drive them out of business.

The theory...would appear to act as a deterrent to competition. It is asking the vendor community to bid at cost, without regard to profit. The obvious question raised by this theory is why would any vendor participate in Government Sealed Bids, by bidding at cost, when a winning bid could be awarded for as little [as a] penny's difference. America's enterprise system relies on the profit motive, this type of contracting will have a *chilling* effect on competition.

In considering the forty-four respondents that replied that there would be "No increase/decrease" in competition, one might conclude that implementing the SPSB method would, in general, be *accepted* by the private industry. If, through further experimentation, the number of competitors remains constant when using the SPSB method, then this conclusion could be substantiated. Unfortunately, no other remarks were provided by these respondents that would clarify their responses. (Also worthy on note, approximately one-half of the private industry contracting professionals surveyed also responded that no change in competition would be expected.)

Of the fifteen Government respondents that believed there *would* be an increase in competition, one stated that "contractors would probably see it [the SPSB method] as an opportunity for windfall profits." Unfortunately, no other statements were provided by these respondents.

Six additional respondents elected not to answer this question.

*g. Question 7: Would you be interested in obtaining additional information concerning the Second Price Solicitation (SPSB) Method?*

In asking this question, it was believed that those Government contracting professionals answering in the affirmative would *consider* using the SPSB method in future Government contracting. Additionally, this question was presented to gauge the level of interest from those in Government regarding the SPSB method. Accordingly, forty-nine of ninety Government respondents (54.4-percent) were *not* interested in obtaining additional information on the SPSB method, while thirty-seven of ninety respondents (41.1-percent) *were* interested. An additional four respondents elected not to answer this question.

*h. Additional comments:*

Several additional comments were received from Government contracting professionals who were concerned that award prices under the SPSB method might not be “fair and reasonable.” As defined by Stanley N. Sherman, a fair and reasonable price is a “price that is fair to *both* parties, considering the agreed-upon conditions, promised quality, and timeliness of contract performance...” [Ref. 11, p. 436] Respondents comments included, “How can a contract be awarded at what should be considered a fair and reasonable price when the award price is based on another offeror’s costs?”

Have you considered whether Second Price Solicitation will result in a reasonable profit? If offerors propose actual cost, the next high[er] offeror’s proposal may be so close as to not provide a reasonable profit - or if there is a disparity between the offers the contract may result in a windfall profit.

The biggest fallacy of this contracting method is the assumption that the differential between the low offeror’s actual cost and the second low offeror’s actual cost represents a “fair and reasonable profit.”

Once again, there is a misunderstanding on the behalf of Government respondents that a margin of profit is *not* included in setting a SPSB price. As was previously discussed, a profit margin *should* be included in a contractor’s bid price, which would ensure the contractor a fair and reasonable award price. However, there could be occurrences where the Government might pay windfall profits which would represent a price that would *not* be considered fair and reasonable.

Consequently, some respondents feel that this situation would result in additional claims and protests.

On a related issue, under the SPSB method, the Government would have to determine price reasonableness on *both* the lowest and the second lowest bidder. As related by one respondent, "in current Government sealed bidding practices, only the lowest bidder's price has to found as price reasonable." Therefore, this would entail an additional "administrative requirement" for the Government.

### **C. A SUMMARY OF THE SPSB METHOD SURVEY - A COMPARISON**

As a summary of the perceptions and opinions cited above, the following *general* observations are provided that compare and contrast survey responses received from Government and private industry.

#### **Question 1: Have you ever been exposed to the Second Price Solicitation (SPSB) Method?**

Virtually *all* Government and private industry respondents had *no* previous exposure to the SPSB method. Accordingly, this survey represents the *first* (initial) opportunity they for them to analyze and provide their perceptions and opinions regarding the SPSB method.

#### **Question 2: If allowed by law, would you as a buyer consider soliciting a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation (SPSB) Method?**

In general, the comments expressed by both Government and private industry regarding this question were the same. In all, approximately fifty-five percent of Government and private industry respondents were hesitant as to whether they would, as a buyer, use the SPSB method. This response stemmed primarily from 1) unfamiliarity with the SPSB method and 2) a lack of test information.

Both Government and private industry respondents choosing *not* use the SPSB method based their response on the uncertainty that the winning bidder would earn an acceptable level of profit. Stated another way, there is no *guarantee* for a return on investment under the SPSB method because the award price is based upon the next lowest bidder's price, which is both unknown and uncontrollable by the winning bidder. Accordingly, pricing strategies under the

SPSB method were perceived as *another* form of game playing. With no definite expectation of profit, the respondents believed there would be no incentive for engaging in the competition.

As stated previously, the above responses reflect a gross misunderstanding of the SPSB method which should include a margin of profit.

**Question 3: If allowed by law, would you as a seller consider submitting a bid for a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation (SPSB) Method?**

Because Government respondents are not “sellers,” they were not asked this question. Therefore, the following is a summary of responses provided from private industry contracting professionals.

Approximately *one-third* of the respondents indicated that they would submit a bid under the terms of the SPSB method. However, most of these respondents had reservations and stated that they would participate only if the Government *insisted* in using the SPSB method. A conclusion, therefore, is that approximately two-thirds of the available contractors might *not* participate, thereby limiting competition.

Of those respondents that were either uncertain, or *not* willing, to participate, their primary concerns included 1) unfamiliarity with the SPSB method, 2) lack of assurances of earning an acceptable level of profit, and 3) the inclusion of artificial rules in sealed bidding which create additional game playing. Additionally, one respondent correctly described the situation where, under the theory of the SPSB method, bid prices submitted are equal a contractor’s cost. Under this situation, the respondent continued, bid prices should then be properly classified as *proprietary information* and be withheld from becoming public knowledge. Otherwise, a contractor’s cost data will become known by its competitors.

With the correct understanding that a contractor’s bid price include a *margin of profit*, contractors would be assured of an acceptable level of profit. Additionally, since specific cost elements are indeterminable through the analysis of bid prices, bid prices should *not* be considered *proprietary information*.

**Question 4: Do you believe that the Second Price Solicitation (SPSB) Method lessens administrative requirements for contractors?**

One-third of the Government contracting professionals believed there would be a *slight* lessening in contractors’ administrative requirements. In sharp contrast, the vast majority of

private industry respondents indicated that there would be *no* change, or an *increase*, in their administrative requirements.

In general, most of the respondents (both Government and private industry) thought there would be no change, or an increase, in contractors' administrative requirements for the following reasons.

- Contractors would still be required to accumulate and analyze their costs which represents a majority of the effort in forecasting expected costs necessary in setting a price.
- Contractors would still be required to monitor competitors' pricing strategies in order to formulate any counter-pricing strategies.
- Contractors would need to accumulate historical profit data/trends in order to make informed decisions concerning a return on investment for future commercial and Government contracts.

Another respondent indicated that when companies begin bidding at cost, higher management approval/scrutiny would also be required which would increase the administrative requirements on behalf of the contractors.

**Question 5: Do you believe that the Second Price Solicitation (SPSB) Method lessens administrative requirements for the Government?**

Roughly one-quarter of both Government and private industry contracting professionals indicated that there would be a *small* decrease in Government administrative requirements.

Similar to the responses in the previous question, the *majority of respondents* believed there would be *no* change, or an *increase*, in administrative requirements for the following reasons.

- The Government would need to determine price reasonableness for *both* the lowest and second lowest bidders.
- The Government would continue to conduct market research necessary in determining that prospective contractors are responsive and responsible.

Additionally, many respondents thought that the SPSB method would generate additional claims and protests, thereby causing an increase in managing litigation matters.

Accordingly, this would impact on administrative requirements for *both* Government and private industry.

**Question 6: Do you believe that the Second Price Solicitation (SPSB) Method would increase or decrease competition?**

*Three* percent of the private industry respondents and almost *seventeen* percent of the Government respondents believed there would be an increase in competition. In considering this difference, one might agree more with private industry's response that there would be little, if any, increase in competition when implementing the SPSB method. After all, private industry determines *who* competes for an award, not Government.

Almost half of all respondents (Government and private industry) believed there would be no change in competition with the introduction of the SPSB method. As mentioned earlier in this chapter, one might conclude from this response that those believing a change in competition would not occur would also believe that contractors would be willing to participate in SPSB solicitations.

Slightly over half of the private industry respondents and one-quarter of the Government respondents thought that competition would actually *decrease*. Both Government and private industry respondents agreed that uncertainties in profit would force contractors to invest into commercial ventures, vice Government. As was succinctly quoted from one of the respondents, "America's enterprise system relies on the profit motive..." Without this, there is no incentive for contractors to compete for Government contracts.

**Question 7: Would you be interested in obtaining additional information concerning the Second Price Solicitation (SPSB) Method?**

As was mentioned previously in this chapter, this question was posed to determine the level of respondents' ongoing interest in the SPSB method. Accordingly, 68.75 percent of private industry respondents and 54.4 percent of Government respondents were *not* interested in receiving additional information on the SPSB method. Furthermore, 31.25 percent of private industry respondents and 41.1 percent of Government respondents were interested.

Accordingly, the overall conclusion is that the majority (i.e., over half) of all respondents would *not* be interested in the SPSB method.

### Additional comments

Several additional comments were provided by both Government and private industry contracting professionals. Overall, these comments did *not* support implementation of the SPSB method for reasons previously stated (i.e., uncertainties in profit and expected increases in game playing).

Additional comments addressed the lack of attaining award prices that would be considered fair and reasonable by *both* Government and private industry. As was further stated, awarding a contract at a price which is determined by a third party (i.e., the next lowest bidder) "does not assure the Government or private industry that the final award price is fair and reasonable." As was repeatedly shown in this chapter, regardless of the next lowest bid price, winning contractors are assured a fair and reasonable price by way of including a margin of profit in their bid price.





## V. CONCLUDING OBSERVATIONS AND RECOMMENDATIONS

To provide a conclusion with recommendations, the research questions posed in Chapter I will be presented and discussed. In addressing each of the primary and subsidiary research questions, the SPSB method described in Chapter II, findings based on experimentation conducted in Chapter III, and information obtained through the survey in Chapter IV will all be discussed. Following this presentation, recommendations and further areas of research will be provided regarding the application of the Second Price Sealed Bid (SPSB) method in Government contracting.

### A. SPSB RESEARCH QUESTIONS

As presented in Chapter I, the primary research question was: *Should the SPSB method be applied in the solicitation of Government contracts?* Prior to providing an answer to this question, each subsidiary question will be addressed.

#### 1. Subsidiary Questions - Discussion

##### a. *Subsidiary Question 1*

*What is the SPSB method as it pertains to Government contracting?* As was discussed in Chapter II, the SPSB method is a method used in contracting where, in a Firm-Fixed Price (FFP) type contract, the award of a contract is given to the lowest bidder who is paid the *next lowest bid price*.<sup>13</sup> Accordingly, under sealed bidding, the criteria presented in Chapter II must be present (e.g., there must be adequate competition, price can be used as an adequate basis for determining award, etc.). Additionally, as a form of sealed bidding, the SPSB method consists of a rigidly structured contracting process, where each step is carefully executed to ensure equitable treatment of bidders while allowing the Government to make an award in a consistent and logical manner. As reiterated from Chapter II, the steps in sealed bidding were presented in the following manner:

- the sealed bid solicitation for an FFP type contract is prepared and publicly announced through various methods (i.e., displaying in public places, mailing or delivery to

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<sup>13</sup> As used here, we assume that the winning bidder is found to be both responsive and responsible.

prospective contractors, or advertising in newspapers, trade journals or Government publications such as the Commerce Business Daily),

- bids are prepared and received from prospective contractors and held, unopened, by the Government,
- bids are then opened by Government officials in a public forum at an appointed time as specified in the solicitation for bid (at this time all contractors and their respective bids are publicly known),
- and award is made to the responsible contractor whose bid is considered most advantageous to the Government (i.e., the contractor that reflects the lowest price and can accomplish the requirements of the solicitation is awarded the contract).

In accordance with the SPSB method, the winning bidder is then paid a price reflected by the next lowest bidder.

#### *b. Subsidiary Question 2*

*Why should the SPSB method be adopted by DoD?* As was delineated in Chapter II, *theoretically*, contractors are incentivized to set their bid price equal to their true cost. As experimentation proved in Chapter III, bidding in this manner maximized contractors' opportunity to win an award in a profitable position. Consequently, the *theoretical* advantages were presented as follows:

1. Costly and time intensive Government administrative requirements (e.g., various administrative requirements involved in PALT) would be eliminated. As a prime example, by knowing what contractors' true costs are (where bid prices are set to true costs), market surveys used in determining price reasonableness would become unnecessary.
2. The most cost efficient contractor will always win the award. The Government is assured that the contractor receiving the award exercises the most cost efficient practices relative to its competitors.
3. Contractors are incentivized to expedite implementation of cost efficient practices. The quicker a contractor can lower the cost of performance, the greater the profits that will be earned because the winning contractor will continue to be paid the next lowest bid price.

4. Contractors are spared the additional time and expense necessary in compiling profit data necessary in developing a competitive bid price. Under the SPSB method, bid prices will *always* be set equal to the true cost to perform.
5. Competition may be stimulated. The simplicity in bid price setting (i.e., setting bid price equal to true cost) may attract prospective contractors in engaging in business with the Government.

As presented below in Subsidiary Question 3, these *theoretical* assumptions will be compared with test results and survey responses discussed in Chapters III and IV.

*c. Subsidiary Question 3*

*Would the SPSB method be an accepted form of solicitation of contracts by Government and/or private industry?* In answering this question, each of the *theoretical* advantages will be listed and compared with testing results reflected in Chapter III and survey responses provided in Chapter IV. Accordingly,

**Theoretical Advantage 1.** *Costly and time intensive Government administrative requirements (e.g., various administrative requirements involved in PALT) would be eliminated. As a prime example, by knowing what contractors' true costs are (where bid prices are set to true costs), market surveys used in determining price reasonableness would become unnecessary.*

As was repeatedly expressed in the survey responses discussed in Chapter IV, the vast majority of *both* Government and private industry respondents believed that the implementation of the SPSB method would either have no change, or *increase*, Government administrative requirements for the following reasons:

- The Government would need to determine price reasonableness for *both* the lowest and second lowest bidder.
- The Government would continue to conduct market research necessary in determining that prospective contractors are *responsive and responsible*.
- The Government would realize an increase in claims and protests, thereby causing an increase in the administration required in managing litigation matters.

The conclusion, therefore, is the likely outcome that there would be *no* change in Government administrative requirements until the SPSB method is better understood.

**Theoretical Advantage 2.** *The most cost efficient contractor will always win the award. The Government is assured that the contractor receiving the award exercises the most cost efficient practices relative to its competitors.*

Chapter III addressed this issue through experimentation. Accordingly, it was determined that this advantage would become more prevalent as contractors become educated in the SPSB method.

**Theoretical Advantage 3.** *Contractors are incentivized to expedite implementation of cost efficient practices. The quicker a contractor can lower the cost of performance, the greater the profits that will be earned because the winning contractor will continue be paid the next lowest bid price.*

Although this advantage was not specifically addressed in experimentation or through the survey, in a competitive market, contractors continually strive to improve production efficiencies to lower the cost of their product, thereby becoming more competitive and profitable. Under the SPSB method, contractors that are able to reduce costs *quicker* than their competitors are able to bid a lower price *and* improve their chances of earning higher profits (i.e., while decreasing their costs, they would still be paid the next lowest bid price offered by a competitor).

**Theoretical Advantage 4.** *Contractors are spared the additional time and expense necessary in compiling profit data necessary in developing a competitive bid price. Under the SPSB method, bid prices will always be set equal to the true cost to perform.*

As was repeatedly expressed in the survey responses discussed in Chapter IV, most Government and private industry respondents believed that the implementation of the SPSB method would either have no change, or *increase*, private industry administrative requirements for the following reasons:

- Contractors would still be required to accumulate and analyze their costs which represents a majority of the effort in forecasting expected costs necessary in setting a price.
- Contractors would still be required to monitor competitors' pricing strategies in order to formulate any counter-pricing strategies.

- Contractors would need to accumulate historical profit data/trends in order to make informed decisions concerning a return on investment for future commercial and Government contracts.
- Contractors would increase the review/approval process by higher management when setting bid prices at cost.

**Theoretical Advantage 5.** *Competition may be stimulated. The simplicity in bid price setting (i.e., setting bid price equal to true cost) may attract prospective contractors in engaging in business with the Government.*

As reflected in *both* Government and private industry survey responses found in Chapter IV, most respondents believed that competition would either *not change*, or *decrease*, with the implementation of the SPSB method. Their belief was primarily based on the uncertainties in profits that would be expected under the SPSB method. In fact, half of the private industry respondents indicated that there would be a *decrease* in competition because commercial ventures would become more lucrative than with Government contracts.

#### *d. Subsidiary Question 4*

*What impediments exist that would preclude the application of the SPSB method in Government Contracting?*

The primary impediment in applying the SPSB method to Government contracting is the unwillingness expressed by *both* Government and private industry contracting professionals. Accordingly, in Chapter IV, the majority of *both* Government and private industry respondents stated that they were either uncertain, or *not* willing, to participate in SPSB solicitations because of 1) their unfamiliarity with the SPSB method, 2) lack of assurances of earning an acceptable level of profit, and 3) artificial rules created under the SPSB method which intensifies game playing. Additionally, there were also legal issues regarding the implementation of the SPSB method. For example, when bidding under the theory of the SPSB method, bid prices submitted *theoretically* represent a contractor's cost (i.e., their bid price should equal their cost). Under this situation, a concern was raised in that these bid prices should be classified as *proprietary information*. Additionally, other respondents believed that the SPSB method would be fraught with claims and protests.

As was repeatedly discussed throughout Chapter IV, *both* Government and private industry respondents *grossly misunderstood* that profit was not included in a contractor's bid price. Accordingly, a margin of profit *should be reflected* in a contractor's bid price. When developing a bid price, contractors should include all relevant cost, to include, for example, a minimal rate of return (or profit) that reflects corporate profit policy.

## **2. Primary Question - Discussion**

*Should the SPSB method be applied in the solicitation of Government contracts?*

Given the overwhelming evidence found in the Chapter IV survey of Government and private industry contracting professionals, one would be inclined *not* to support the SPSB method. After careful consideration, "cultural" uncertainties exist with the SPSB method which strongly indicates a *resistance* to change. By far, the greatest impediment perceived by *both* Government and private industry contracting professionals is the lack of assurances that an award price under the SPSB method results in an acceptable rate of return for contractors, *and* that this SPSB price represents a fair and reasonable price for *both* Government and private industry. Respondents to the Chapter IV survey *clearly* expressed concerns that a price set by a third party (i.e., the next lowest bid price) could not guarantee a fair and reasonable price, nor represent a return on investment that is acceptable to contractors' interests (e.g., a return on investment that satisfies stockholders' desires). *However, this thesis clearly identifies the misconceptions regarding the SPSB method on behalf of both Government and private industry.* With the complete understanding that SPSB prices *should* include a margin of profit, both Government and private industry respondents would increase the likelihood of accepting the SPSB method. This speculation is based on the fact that contractors would include a margin of profit in their bid prices that *would* be considered *fair and reasonable*. Consequently, one would also expect competition *not* to decrease with the implementation of the SPSB method.

Accordingly, the recommendation of this thesis is to further educate Government and private industry regarding their misconceptions of the SPSB method. With a full understanding of the critical issues/shortfalls discussed in this thesis, future application of the SPSB method in Government contracting appears promising.

## B. AREAS FOR FURTHER RESEARCH

There have been various aspects of this thesis that would warrant additional research. Accordingly, they are as follows:

- The two experimental approaches and the survey discussed in this thesis did not fully address the concept of "cost of profit" as defined in the economic sense where a contractor's true cost *should include* a margin of profit. As such, a contractor's bid price should reflect a profit "cost" element which would assure contractors a fair and reasonable award price. Accordingly, future experiments and surveys would be recommended that fully identify this concept. Accordingly, these results should prove more revealing than what was presented in this thesis.
- Although not related to contracting, additional research has been completed in second-price theory by David Porter of the California Institute of Technology which was not included in this thesis. Further research in the SPSB method should include his work as it applies to contracting.

## C. FINAL THOUGHTS

Although the findings of this thesis are somewhat discouraging for those supporting the SPSB method, there are several avenues for further research that may eventually manifest itself in one form or another in Government contracting. In retrospect to the findings of this thesis, one must recognize that second-pricing and the SPSB method were *relatively new concepts* for both the graduate students who participated in the experimentation discussed in Chapter III and the respondents of the Chapter IV survey. Perhaps, after further experimentation, exposure, and education in second-price theory, these individuals may be more inclined to accept this innovative concept and encourage its application in future Government contracting. After all, Rome was not built in a day.





## APPENDIX A. A LIST OF GOVERNMENT AND INDUSTRY SURVEYED

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Defense Commissary Agency  
East Service Agency  
Attn: Contracting Division  
Fort Lee, VA 23801-6300

Defense Commissary Agency  
Southwest Region  
Attn: Contracting Division  
MCAS El Toro Building 317  
Santa Ana, CA 92709-5002

Defense Commissary Agency  
Northeast Region  
Attn: Contracting Division  
Fort Meade, MD 20755-5220

Defense Commissary Agency  
Northwest Region  
Attn: Contracting Division  
Fort Lewis, WA 98443-7300

Defense Commissary Agency  
West Service Division  
Attn: Contracting Division  
Kelly AFB, TX 78241-6290

Defense Commissary Agency  
Midwest Region  
Attn: Contracting Division  
Kelly AFB, TX 78241-6290

Defense Commissary Agency  
Southern Region  
Attn: Contracting Division  
Maxwell AFB, AL 36112-6722

Defense Commissary Agency  
Central Region  
Attn: Contracting Division  
Naval Amphibious Base, Norfolk, VA 23511

U.S. Army Information System Selection and Acquisition Agency  
Hoffman I Bldg.  
Attn: SADBUE  
2461 Eisenhower Ave.  
Alexandria, VA 22331-0700

Naval Regional Contracting Center  
Attn: Deputy for Small Business, Code OB,  
Bldg. 53, Terminal Island  
Long Beach, CA 90822-5095

Air Force Communication Center  
Scott Air Force Base  
Attn: Small Business Specialist  
Belleville, IL 62225-6001

Defense Logistics Agency  
Office of Telecommunications and Information Systems  
ADP Contracting Division  
Cameron Station, Alexandria, VA 22304-6100

Naval Regional Contracting Center Code 01  
4th Floor, Building 200  
Washington Navy Yard  
Washington, DC 20374-2000

Commander  
Defense Supply Service Washington  
Rm. 1D254  
The Pentagon  
Washington, DC 20310-5200

Commander  
Space and Naval Warfare Systems Command  
Code SPAWAR-OOK  
Washington, DC 20363-5100

Commander  
Naval Sea Systems Command  
Code 02K  
Crystal Park #1, Room 1102  
Washington, DC 20362-5101

Commander  
Naval Regional Contracting Center  
Code 09B,  
U.S. Naval Base, Bldg. 600  
Philadelphia, PA 19112-5802

Commander  
Navy Aviation Supply Office  
Code 093  
700 Robbins Avenue  
Philadelphia, PA 19111-5098

Commander  
Navy Ships Parts Control Center  
Code 006  
P.O. Box 2020,  
Mechanicsburg, PA 17055-0788

Commander  
Mare Island Naval Shipyard  
Code 533  
Supply Department  
Vallejo, CA 94592-5100

Commander  
Pearl Harbor Naval Shipyard  
Code 530  
Box 400  
Pearl Harbor, HI 96860-7300

Commander  
Portsmouth Naval Shipyard  
Code 530  
Bldg. 153, Room 15  
Portsmouth, NH 03801-2590

Commander  
Philadelphia Naval Shipyard  
Code 500.03  
U.S. Naval Base  
Philadelphia, PA 19112

Commander  
Norfolk Naval Shipyard  
Code 500S  
Bldg. 1500  
Portsmouth, VA 23709-5000

Commander  
Naval Submarine Base New London  
Code 244.4, Box 500  
Bldg. 87-2  
Groton, CT 06349-5000

Commander  
Naval Air Engineering Center  
Code OOM, Bldg. 129  
Lakehurst, N.J. 08733-5028

Commander  
Naval Air Development Center  
Code 094  
Warminster, PA 18974-5000

Commander  
Naval Weapons Center  
Code 2503  
China Lake, CA 93555-6001

Commander  
Navy Resale and Services Support Office  
Naval Station Staten Island  
Code CGR  
Bldg. 210  
Staten Island, NY 10305-5097

Commander, Northern Division  
Naval Facilities Engineering Command, Code 09J  
Bldg. 77L  
Naval Base  
Philadelphia, PA 19112

Commander, Chesapeake Division  
Naval Facilities Engineering Command, Code 09J  
Bldg. 212  
Washington Navy Yard  
Washington, DC 20374-2121

Commander, Atlantic Division  
Naval Facilities Engineering Command, Code 09J  
Norfolk Naval Base, Norfolk, VA 23511-6287

Commander, Southern Division  
Naval Facilities Engineering Command, Code 09J,  
P.O. Box 10068  
Charleston, SC 29411-0068

Commander, Western Division  
Naval Facilities Engineering Command, Code 09J  
900 Commadore Drive  
P.O. Box 727  
San Bruno, CA 94066-0720

Commander, Pacific Division  
Naval Facilities Engineering Command, Code 09J  
Pearl Harbor, HI 96860

DCMAO Baltimore  
200 Townsontown Blvd. West  
Townson, MD 21204-5229

DCMAO Dayton  
1507 Wilmington Pike  
Bldg. No. 1  
Dayton, OH 45444-5300

DCMAO Philadelphia  
2800 South 20th Street  
P.O. Box 7478  
Philadelphia, PA 19101-7478

DCMAO Bridgeport  
555 Lordship Blvd.  
Bridgeport, CT 06497-7124

DCMAO Buffalo  
1103 Federal Building  
111 West Huron Street  
Buffalo, NY 14202-2392

DCMAO Garden City  
605 Stewart Avenue  
Long Island, NY 11530-4761

DCMAO Birmingham  
2121 8th Avenue, North  
Suite 104  
Birmingham, AL 35203-2376

DCMAO Dallas  
1200 Main Street  
Dallas, TX 75202-9205

DCMAO Hartford  
130 Darlin Street  
East Hartford, CT 06108-3234

DCMAO Boston  
495 Summer Street  
Boston, MA 02210-2184

DCMAO Syracuse  
615 Erie Blvd., West  
Syracuse, NY 13204-2408

DCMAO New York  
201 Varick Street  
Room 1061  
New York, NY 10014-4811

DCMAO San Antonio  
615 East Houston Street  
P.O. Box 1040  
San Antonio, TX 78294-1040

DCMAO Pittsburgh  
1612 Federal Building  
1000 Liberty Avenue  
Pittsburgh, PA 15222-4190

DCMAO Detroit  
905 McNamara Federal Building  
477 Michigan Avenue,  
Detroit, MI 48226-2506

DCMAO Cleveland  
AJC Federal Office Building  
1240 East Ninth Street  
Room 1431  
Cleveland, OH 44199-2064

DCMAO Philadelphia  
2800 South 20th Street  
P.O. Box 7699  
Philadelphia, PA 19101-7699

DCMAO Reading  
45 South Front Street  
Reading, PA 19602-1094

DCMAO Denver  
Orchard Place 2, Suite 2  
5975 Greenwood Plaza Blvd.  
Englewood, CO 80111-4715

DCMAO Indianapolis  
Finance Center  
US Army, Building 1  
Ft Benjamin Harrison 46249-5701

DCMAO Chicago  
O'Hare International Airport  
P.O. Box 66911  
Chicago, IL 60666-0911

DCMAO Cedar Rapids  
1231 Park Place NE  
Cedar Rapids, IA 49504-5352

DCMAO Wichita  
U.S. Court House  
401 N. Market  
Suite B34  
Wichita, KS 67202-2095

DCMAO Grand Rapids  
Riverview Center Building  
678 Front Street, NW  
Grand Rapids, MI 49504-5352

DCMAO St. Louis  
1222 Spruce Street  
St. Louis, MO 63103-2811

DCMAO Twin Cities  
3001 Metro Drive  
Bloomington, NM 55425-1911

DCMAO Milwaukee  
310 West Wisconsin Avenue  
Milwaukee, WI 53203-2216

DCMAO El Segundo  
222 N. Sepulveda Boulevard  
El Segundo, CA 90245-4320

DCMAO Van Nuys  
6230 Van Nuys Blvd.  
Van Nuys, CA 91401-2713

DCMAO Santa Ana  
34 Civic Center Plaza  
P.O. Box C-12700  
Santa Ana, CA 92712-2700

DCMAO San Diego  
7675 Dogget Street  
Suite 200  
San Diego, CA 92111-2241

DCMAO San Francisco  
1250 Bay Hill Drive  
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DCMAO Seattle  
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Naval Station Puget Sound  
Seattle, WA 98115-5010

DPRO Pratt and Whitney East Hartford  
400 Main Street  
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DPRO General Electric  
Aircraft Engines, Lynn  
1000 Western Avenue  
Lynn, MA 01910-0445

DPRO Boeing Helicopter  
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DPRO Westinghouse Baltimore  
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Mr. Joel Marsh, Director Acquisition Policy  
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Mr. Joe Porch, Division Vice President Contracts  
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## **APPENDIX B. SURVEY QUESTIONS WITH COVER SHEETS**

### **SURVEY OF THE SECOND PRICE SOLICITATION METHOD**

This survey is designed to elicit professional contract management opinions as they pertain to the solicitation of *Firm-Fixed type contracts (sealed bid) under \$100,000* using the *Second Price Solicitation Method*. This survey is being presented to both contractors and various Government contracting officials to provide differing perspectives on the application of this solicitation method.

**What is the Second Price Solicitation Method?** In contrast with the commonly used *First Price Solicitation Method* used in soliciting Firm-Fixed (sealed bid) type contracts, where the lowest bidder is awarded the contract and paid the amount of their bid, the *Second Price Solicitation Method* awards the contract to the lowest bidder and is *paid the amount of the next-to-lowest bid*. **Theoretically**, in a competitive environment, contractors' best long-term strategy for submitting bids under the Second Price Solicitation Method is to bid their actual costs for the following reasons,

- 1) bidding *higher* than their actual costs increases the risk of not being the lowest bidder, therefore losing the award and,
- 2) bidding *lower* than their actual costs increases the risk of being awarded a contract in an unprofitable position (this would occur where the next-to-lowest bid is *also* lower than their actual costs).

Continuing with this theory, contractors would then accumulate their actual costs and bid this sum without expending management efforts in formulating a pricing strategy (i.e., management would not have to expend administrative efforts in determining a competitive profit position). Accordingly, market surveys and audits performed by the Government to determine price/cost reasonableness would become unnecessary. Free market competitive forces between contractors would disclose their actual costs as reflected in their bids.

As a final note, the Second Price Solicitation Method is an alternative contract solicitation method that is being analyzed under the umbrella of "Reinventing Government." Although this method is currently not supported by statute or regulation, this survey assumes that it is supported by law and your responses should take this under consideration.

## **SECTION I: RESPONDENT BACKGROUND AND EXPERIENCE**

- A1. Select the answer(s) that most nearly describes your position in your present organization:
- a. Government contracts management that either formulates, issues, or audits Government contract policy.
  - b. Government contracting specialist (e.g., those individuals who either drafts, solicits, awards contracts or performs post-contract administration).
  - d. Non-Government contracts management (i.e., senior/executive management).
  - e. Non-Government contracting specialist (e.g., those individuals who either drafts, solicits, awards contracts or prepares bid proposals)
  - f. Other, please specify: \_\_\_\_\_.
- A2. How many years experience have you in the procurement/contracting field?
- a. 1 year or less
  - b. 1 to 3 years
  - c. 3 to 5 years
  - d. 5 to 10 years
  - e. Over 10 years
- A3. How many years have you been directly involved with Firm-Fixed type contracting?
- a. 1 year or less
  - b. 1 to 3 years
  - c. 3 to 5 years
  - d. 5 to 10 years
  - e. Over 10 years
- A4. For non-Government contractors, your company is considered:
- a. Small business
  - b. Large business.

## **SECTION II: SECOND PRICE SOLICITATION SURVEY QUESTIONS**

- B1. Have you ever been exposed to the Second Price Solicitation Method?
- a. Yes.
  - b. No.
- If yes, please elaborate: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- B2. If allowed by law, would you as a *buyer* consider soliciting a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation Method?
- a. Yes, definitely.
  - b. Yes, with reservations.
  - c. Neutral/uncertain.
  - d. No.
- If no or neutral, please elaborate: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**B3. To be answered by Non-Government:** If allowed by law, would you as a *seller* consider submitting a bid for a Firm-Fixed (sealed bid) type contract using the Second Price Solicitation Method?

- a. Yes, definitely.
- b. Yes, with reservations.
- c. Neutral/uncertain.
- d. No.

If no or neutral, please elaborate: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**B4. Do you believe that the Second Price Solicitation Method lessens administrative requirements for contractors?**

- a. Yes, extensively.
- b. Yes, to a small extent.
- c. No.

If no, please elaborate: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**B5. Do you believe that the Second Price Solicitation Method lessens administrative requirements for the Government?**

- a. Yes, extensively.
- b. Yes, to a small extent.
- c. No.

If no, please elaborate: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**B6. Do you believe that the Second Price Solicitation Method would increase or decrease competition?**

- a. Definite increase.
- b. Probable increase.
- c. No increase/decrease.
- d. Probable decrease.
- e. Definite decrease.

**B7. Would you be interested in obtaining additional information concerning the Second Price Solicitation Method?**

- a. Yes.
- b. No.

B8. Please comment on any aspect of the Second Price Solicitation Method you feel is noteworthy. Thank you for your participation.

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## APPENDIX C. EXPERIMENTS 1 - 4/PHASES I & II

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### EXPERIMENT 1 - PHASE I

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#### First Price & Second Price (Sealed Bid) Solicitations

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#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 infrared sensors**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten infrared sensors is \$(a random generated cost-to-manufacture figure in the range of \$9,000-1,100 for each group is inserted here).

b. The technology required to manufacture the sensors is relatively mature with an average industry-wide cost to manufacture ten sensors at \$1,000. Historically, the electronics industry earned an average of 8% profit in the sale of infrared sensors. Accordingly, the average industry-wide price for ten infrared sensors is \$1,080 ( $\$1,000 + 1,000 \times 8\% = \$1,080$ ).

c. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

#### 2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

---

---

## EXPERIMENT 1 - PHASE II

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 microprocessors for the AIMS-9X missile system**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten microprocessors is \$(a random generated cost-to-manufacture figure in the range of \$8,000-12,000 for each group is inserted here).

b. The technology required to manufacture the microprocessors is state-of-the-art. Accordingly, obtaining market survey information is not available to predict your competitors' bid proposals.

c. In general, the electronics industry earns an average of 12% profit in the sale of microprocessors.

d. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

#### 2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

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## EXPERIMENT 2 - PHASE I

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 infrared sensors**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten infrared sensors is \$(a random generated cost-to-manufacture figure in the range of \$9,000-11,000 for each group is inserted here).

b. The technology required to manufacture the sensors is relatively mature with an industry-wide average cost to manufacture ten sensors at \$10,000. Historically, the electronics industry earned an average of 8% profit in the sale of infrared sensors. Accordingly, the average price requested for the infrared sensor is \$10,800 ( $\$10,000 + 10,000 \times 8\% = \$10,800$ ).

c. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

---

---

## EXPERIMENT 2 - PHASE II

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 microprocessors for the AIMS-9X missile system**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten microprocessors is \$(a random generated cost-to-manufacture figure in the range of \$3,000-7,000 for each group is inserted here).

b. The technology required to manufacture the microprocessors is state-of-the-art. Accordingly, obtaining market survey information is not available to predict your competitors' bid proposals.

c. In general, the electronics industry earns an average of 12% profit in the sale of microprocessors.

d. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

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## EXPERIMENT 3 - PHASE I

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 infrared sensors**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten infrared sensors is \$(a random generated cost-to-manufacture figure in the range of \$9,00-1,100 for each group is inserted here).

b. The technology required to manufacture the sensors is relatively mature with an average industry-wide cost to manufacture ten sensors at \$1,000. Historically, the electronics industry earned an average of 8% profit in the sale of infrared sensors. Accordingly, the average industry-wide price for the infrared sensor is \$1,080 ( $\$1,000 + 1,000 \times 8\% = \$1,080$ ).

c. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

#### 2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

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## EXPERIMENT 3 - PHASE II

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 microprocessors for the AIMS-9X missile system**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten microprocessors is \$(a random generated cost-to-manufacture figure in the range of \$8,000-12,000 for each group is inserted here).

b. The technology required to manufacture the microprocessor is state-of-the-art. Accordingly, obtaining market survey information is not available to predict your competitors' bid proposals.

c. In general, the electronics industry earns an average of 12% profit in the sale of microprocessors.

d. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

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## EXPERIMENT 4 - PHASE I

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 infrared sensors**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten infrared sensors is \$(a random generated cost-to-manufacture figure in the range of \$9,000-11,000 for each group is inserted here).

b. The technology required to manufacture the sensors is relatively mature with a industry-wide average cost to manufacture ten sensors at \$10,000. Historically, the electronics industry earned an average of 8% profit in the sale of infrared sensors. Accordingly, the average price requested for the infrared sensors is \$10,800 ( $\$10,000 + 10,000 \times 8\% = \$10,800$ ).

c. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

2. **Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

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## EXPERIMENT 4 - PHASE II

### First Price & Second Price (Sealed Bid) Solicitations

---

#### Definition

**First Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of their bid.

**Second Price Sealed Bid Solicitation** - Award goes to the lowest bidder and is paid the amount of the next to lowest bid.

---

1. Your company is a manufacturer of various electronic components and is considering to bid on a **Government solicitation for 10 microprocessors for the AIMS-9X missile system**:

a. Your company's total cost (i.e., labor, material, and overhead costs) to manufacture ten microprocessors is \$(a random generated cost-to-manufacture figure in the range of \$3,000-7,000 for each group is inserted here).

b. The technology required to manufacture microprocessors is state-of-the-art. Accordingly, obtaining market survey information is not available to predict your competitors' bid proposals.

c. In general, the electronics industry earns an average of 12% profit in the sale of microprocessors.

d. The economy is steadily growing and there is expected to be in excess of 10 competitors submitting bids for this solicitation.

**2. Required:**

a. Provide a bid under the terms of a **First Price Sealed Bid Solicitation** with rationale for your pricing strategy.

b. Provide a bid under the terms of a **Second Price Sealed Bid Solicitation** with rationale for your pricing strategy.

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## APPENDIX D. RANDOM COST-TO-MANUFACTURE

Appendix D is a listing of random cost-to-manufacture figures which were used in the classroom experimentation found in Chapter III. Accordingly, the Microsoft Excel Random Number Generator provided a uniform distribution within the ranges indicated below.

Microsoft Excel				
Random Number Generation				
	900-1,100	9,000-11,000	3,000-7,000	8,000-12,000
1	913	10,760	4,780	8,021
2	1,036	9,376	6,310	9,425
3	1,073	10,691	4,350	9,820
4	959	9,709	6,618	9,794
5	963	9,422	3,813	11,445
6	909	10,009	6,746	8,614
7	1,081	9,968	4,858	8,219
8	992	9,244	4,412	9,648
9	904	10,030	6,206	9,899
10	947	10,597	3,060	9,717
11	1,025	10,817	4,971	11,992
12	1,043	9,306	6,280	11,645
13	907	10,643	5,832	8,239
14	1,036	10,476	4,943	8,827
15	966	9,687	3,708	10,867
16	1,091	10,200	4,927	10,602
17	1,070	10,398	5,293	8,039
18	1,078	9,081	4,425	9,176
19	907	10,733	3,456	9,305
20	1,095	9,057	3,733	8,658
21	906	10,091	4,827	10,300
22	1,056	10,449	3,659	11,484
23	1,030	9,580	3,150	11,958
24	1,015	10,813	3,715	9,413
25	910	10,498	5,916	9,557



# APPENDIX E. EXPERIMENTS 1 - 5, SECOND PRICE AUCTION

Experiment 1, Second Price Auction							
Round 1				Round 2			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	9354	9354	=	1	7503	7503	=
2	<u>9789</u>	10000	<	2	7865	7864	>
3	9998	<u>9950</u>	>	3	8659	<u>8639</u>	>
4	8915	6500	>	4	8135	8135	=
5	9254	9255	<	5	<u>8800</u>	8850	<
6	8562	6850	>	6	7286	6552	>
7	9687	9600	>	7	7684	7700	<
8	9543	9543	=	8	7951	7960	<
9	8264	8264	=	9	8256	8250	>
10	8176	8000	>	10	8169	8100	>
Group	2			Group	5		
Profit	-161	% Var =	4.62	Profit	161	% Var =	0.94
Round 3				Round 4			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	6824	6824	=	1	8930	8930	=
2	6853	6800	>	2	8910	8910	=
3	6950	<u>6945</u>	>	3	8920	8920	=
4	6923	6923	=	4	8940	8940	=
5	6897	6900	<	5	8900	8901	<
6	6975	6417	>	6	8960	8881	>
7	<u>6854</u>	6954	<	7	8980	<u>8980</u>	=
8	6910	6920	<	8	<u>9000</u>	9010	<
9	6875	6875	=	9	8970	8970	=
10	6798	6790	>	10	8950	8890	>
Group	7			Group	8		
Profit	-91	% Var =	0.74	Profit	20	% Var =	0.14

**Experiment 2, Second Price Auction**

Round 1				Round 2			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	9354	9354	=	1	7503	7506	<
2	9789	9790	<	2	7865	7866	<
3	<u>9998</u>	55000	<	3	<u>8659</u>	100000	<
4	8915	8915	=	4	8135	8253	<
5	9254	9254	=	5	8800	8800	=
6	8562	8562	=	6	7286	7286	=
7	9687	<u>16000</u>	<	7	7684	7685	<
8	9543	9600	<	8	7951	8025	<
9	8264	8164	>	9	8256	<u>18256</u>	<
10	8176	8176	=	10	8169	8169	=
Group	3			Group	3		
Profit	-6,002	% Var =	56.01	Profit	-9597	% Var =	126.44
Round 3				Round 4			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	6824	6890	<	1	<u>8930</u>	10000	<
2	6853	6854	<	2	8910	8911	<
3	6950	6950	=	3	8920	8920	=
4	6923	<u>7023</u>	<	4	8940	9040	<
5	6897	6897	=	5	8900	8900	=
6	6975	6975	=	6	8960	8960	=
7	6854	7000	<	7	8980	9000	<
8	6910	6950	<	8	9000	9105	<
9	<u>6875</u>	7200	<	9	8970	<u>9170</u>	<
10	6798	6798	=	10	8950	8950	=
Group	9			Group	1		
Profit	-148	% Var =	0.98	Profit	-240	% Var =	1.67

**Experiment 3, Second Price Auction**

Round 1				Round 2			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	9354	9355	<	1	7503	7703	<
2	9789	<u>9780</u>	>	2	7865	7865	=
3	<u>9998</u>	10001	<	3	8659	8659	=
4	8915	9003	<	4	8135	<u>10006</u>	<
5	9254	9253	>	5	8800	9000	<
6	8562	8580	<	6	7286	7350	<
7	9687	9687	=	7	7684	7684	=
8	9543	9543	=	8	7951	7951	=
9	8264	9764	<	9	8256	8556	<
10	8176	8200	<	10	<u>8169</u>	12000	<
Group	3			Group	10		
Profit	218	% Var =	1.77	Profit	-1837	% Var =	8.05
Round 3				Round 4			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	6824	6945	<	1	8930	8935	<
2	6853	<u>7250</u>	<	2	8910	9000	<
3	<u>6950</u>	6950	=	3	8920	8920	=
4	6923	7004	<	4	8940	9003	<
5	6897	7001	<	5	8900	8950	<
6	<b>6975</b>	7135	<	6	8960	<u>9100</u>	<
7	6854	6854	=	7	8980	8980	=
8	6910	6910	=	8	9000	9000	=
9	<u>6875</u>	<b>8875</b>	<	9	8970	9000	<
10	6798	7000	<	10	<u>8950</u>	10000	<
Group	9			Group	10		
Profit	-375	% Var =	4.45	Profit	-150	% Var =	1.60

**Experiment 4, Second Price Auction**

Round 1				Round 2			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	850	850	=	1	500	500	=
2	1000	<u>1000</u>	=	2	<u>600</u>	<b>650</b>	<
3	<u>750</u>	<b>1000000</b>	<	3	625	<u>625</u>	=
4	800	999	<	4	550	1	>
5	950	949	>	5	525	600	<
6	900	900	=	6	575	570	>
7	850	900	<	7	500	600	<
8	750	751	<	8	600	601	<
9	950	949	>	9	<u>650</u>	<b>650</b>	=
10	800	800	=	10	600	600	=
Group	3			Group	2&9		
Profit	250	% Var =	11622.07	Profit	-25 & 25	% Var =	5.73
Round 3				Round 4			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	<u>750</u>	<b>1000</b>	<	1	900	<u>1000</u>	<
2	700	701	<	2	950	951	<
3	650	650	=	3	<u>1000</u>	<b>1001</b>	<
4	800	825	<	4	700	1000	<
5	750	850	<	5	650	700	<
6	800	800	=	6	850	850	=
7	650	<u>777</u>	<	7	575	600	<
8	750	751	<	8	625	626	<
9	900	<u>900</u>	=	9	800	800	=
10	650	650	=	10	600	600	=
Group	1			Group	3		
Profit	-150	% Var =	6.81	Profit	1	% Var =	6.25

**Experiment 5, Second Price Auction**

Round 1				Round 2			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	850	846	>	1	500	500	=
2	1000	<u>1000</u>	=	2	600	600	=
3	750	750	=	3	625	<u>625</u>	=
4	800	800	=	4	550	550	=
5	950	950	=	5	525	526	<
6	900	925	<	6	<u>575</u>	<b>650</b>	<
7	850	850	=	7	500	500	=
8	750	751	<	8	600	601	<
9	<u>950</u>	<b>1000000</b>	<	9	<u>650</u>	<b>650</b>	=
10	800	800	=	10	600	601	<
Group	9			Group	6 & 9		
Profit	-50	% Var =	11617.12	Profit	-50&25	% Var =	1.36
Round 3				Round 4			
Group	Value	Bid	Strategy	Group	Value	Bid	Strategy
1	750	750	=	1	900	<u>900</u>	=
2	700	700	=	2	<u>950</u>	<b>950</b>	=
3	<u>1000</u>	<b>1000</b>	=	3	650	650	=
4	800	800	=	4	700	700	=
5	750	751	<	5	650	650	=
6	800	800	=	6	850	850	=
7	650	650	=	7	575	575	=
8	750	751	<	8	625	626	<
9	900	<u>924</u>	<	9	600	625	<
10	650	650	=	10	600	601	<
Group	3			Group	2		
Profit	76	% Var =	0.34	Profit	50	% Var =	0.38





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